

MARIJUANA Horticulture

The Indoor/Outdoor

MEDICAL

Grower's Bible

by JORGE CERVANTES

In Memoriam:

Steven McWilliams

Scared of possible jail time, in constant pain and tired of battling for medical marijuana patients' rights, Steven McWilliams committed suicide in San Diego on Monday July 11, 2005 on his 51st birthday.

Mr. McWilliams was famous nation-wide for his efforts and the legitimacy he lent to the medical marijuana movement. Not taken seriously at first, McWilliams did not give up, working for the movement since as early as 1996 when California state voters approved Proposition 215, allowing patients to use marijuana for medical purposes when prescribed by a doctor.

Steven McWilliams worked to implement Proposition 215 locally in San Diego. Showing up weekly for City Council meetings carrying a marijuana plant, he urged the local politicians to come up with a plan for the distribution of marijuana. As a result the city came up with standards for the number of plants allowed by users. Mr. McWilliams served on a city-organized committee for a time that dealt with these issues. He ran for city council a few times, when he wasn't alternately suing the city.

In spite of all this, he was convicted in 2003 for illegal cultivation, and sentenced to a six-month federal prison term. Still out on appeal at the time of his suicide, he was in chronic and serious pain, the judge had ordered that he not use marijuana. Mr. McWilliams suffered severe side

Dedication

This book is dedicated to Sebastain Orfali; Roger Watanabe; my mother, father, wife and family; all cannabis medical patients; and all the people who have suffered the effects of the War on (prohibited cannabis) Drugs. We share a common affliction. Some law enforcement and political agents have shared our pain; others are in different stages of denial. May the Christian God, Buddah, Alai, Sheeba, and the God you worship, bless you all.

effects from the use of standard prescription painkillers. He left a note saying that the pain was too much to bear, and he hoped his suicide would help change the government's position towards marijuana as a medicine.

Memorial services were held in San Diego at City Hall, white roses were passed to the attendees.

Steph Sherer, executive director of Americans for Safe Access said, "Steve McWilliams was tortured by the federal government because of the medication he needed."



The Native Suns Dispensary opened in San Diego on June 6, 2005, in defiance of the Supreme Court's ruling against individual states' medical marijuana laws. In a 6-3 split-decision, Justice Paul Stevens said that congress has a moral responsibility to change the nation's laws regarding cannabis use for medical patients. In writing the decision, Justice Stevens did find that the federal government did not exceed its authority under law when federal officers raided medical marijuana patients with California state prescriptions.

Credits

Some information in this book was extrapolated from the "Frequently Asked Questions" and "Forums" found at www.overgrow.com. This list contains OG member names and some of the many people who made this book possible.

It has been a long and winding road. Many, many wonderful people have helped make this book a reality. I have listed everybody in alphabetical order. To clarify, some of the people below provided inspiration, others hard facts, and among them, some gave much more than others. We know who we are, and we are together!

Extra special thanks to Chimera who added precision and knowledge to the breeding chapter. He is an expert!

10K
Adam (Hempworks/THSeeds)
Al (Insta Print)
Alan Dronkers (Sinsi)
Albert (Sensi)
Aleen
Alex (not Lying Sack of Shit Alex)
Allen St. Pierre, (NORML)
André Grossman (*High Times*)
Annie
Apollo11Genius
Arjian (Greenhouse)
Aurora
Badar
Balta
Barbas
Barge
Barry (*Australian Hydroponics*)
Bean (*High Times*)
Ben Dronkers (Sensi)
Bernard Rapaz (Valchanvre)
Bev
Beverly Potter
Biddy

BigIslandBud
Bill C.
Bill Drake (Author)
Bill K.
Bill R.
Bill
BOG (overgrow.com)
Boy Ramsahai (*High Life* and *Soft Secrets*)
Breeder Steve (Spice of Life)
Bubbasix
Bubble Man
Buddy R.
Bud-E
Carlos Cholula
Carlos Hernandez
Cezar Doll (*Cañamo*)
Charlie F.
Charlie
Chimera (Chimera Seeds)
Chris Conrad
Chris I.
Chris Payaso
Chris Simunek (*High Times*)
Cliff Cremer (*High Life* and *Soft Secrets*)
Connie (*Hanf*)
Consuelo
Cosmic Jimmy
Crow
Crystal (Kind Seeds)
D. B. Turner
D. C.
D.J. Short (DJ Short Seeds)
DaChronicKing
Dan (Vancouver, BC)
Dana Larson (*Cannabis Culture*)
Darryll (Kind Seeds)
Daryll
Dave Bienenstock (*High Times*)
David Strange (*Heads*)
David T.
David W.
David Watson
David
Dennis (*Grass Times*)
Dennis Peron
Dennis S.
Dennos
Derry (Barney's)
Deva
Dieter Hagenbach
Dirk Rehahan
Doc Ontario
Doctor Dangerous
Don Collins
Donny

Doug (Hempworks/THSeeds)
Dr. John McPartland (*Hemp Diseases and Pests*)
Drew Bennie
Dutch Grown
Eagle Bill (RIP)
Ed Rosenthal (Author)
Eddie (Flying Dutchmen)
Eirik
Elizabeth
Elmar (BTT)
Emilio Gómez
Enric
Ernesto (*Cañamo*)
Evie
Farmer in the Sky
Fatima
Felipe Borallo (Makoki)
Felipe
Felix Kaatz (Owl's Production)
Feran (Good House Seeds)
Fergetit
Fergetit
Flick
Fluus
Foz
Frank (Canna)
Frank
G. I. Joe
Gaspar Fraga (*Cañamo*)
Gato
George
Gillis (Canna)
Gisela
Glass Joe
Gloria (Kind Seeds)
Gonz
Gordon
Grant
Gregorio (Goyo) Fernandez
Guido (Hanfblatt)
Gurney
Gypsy Nirvana (Seeds Direct)
Hank
Harmon D.
HashMan
HempHappy
Henk (Dutch Passion)
Henk (HESI)
Hilary Black (Vancouver Compassion Club)
Hillary Black
Hugo (*Soft Secrets*)
Ivan (Ivanart)
ixnay007
Jack Herrer
Jaime Pratz (*Cañamo*)
Jan Sennema
Jan

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Javi (The Plant)
 Javi
 Javis
 Jerry smp
 Jim from Chicago
 Jim R.
 Jim
 Jimmy Chicago
 JJ Jackson (Advanced Hydroponics)
 JJ Turner
 Joan Melendez
 John (Avalon)
 John
 Joint Doctor (Low Ryder)
 Jordi Bricker (*Cañamo*)
 Josete (*Cañamo*)
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 Juan
 Juaquin (El Conde) Bucati
 Karen (The Amsterdam)
 Karulo (l'Interior)
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 Roger (*Nacht-Schatten Verlag*)
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 Sebastain Orfali RIP
 Sergi Doll (*Cañamo*)

Shantibaba (Mr. Nice)
 Simon (Serious)
 Sita
 Sixfinger
 Skip Higdon
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 Skip
 Snoofer
 Soma (Soma)
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 Steve from OZ
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 Steve Solomon
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 Taylor (Kind Seeds)
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 Ted Zitlau, RIP
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 Tom Flowers (*Marijuana Flower Forcing*), RIP
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 Wernard Bruining,
 Whirly
 William
 Willie (*Hanfblatt Tuner*)
 Winnie (*Grow!*)
 Wismy (*Yerba*)
 Xavi
 Xus
 Yorgos
 Ztefan (CannaTrade)

Countless growers and cannabis aficionados (that were not named above) helped with this book. They provided valuable input and support over the last 20 years to make this book possible.

The War on Drugs

The War on Drugs in "America, Land of the Free" is out of control. This War on American citizens and many other unfortunate souls around the world continues to be driven by fear and misinformation that is spun by numerous US and foreign government agencies.

The War on Drugs concentrates on incarcerating cannabis users and is headed by a drug czar.

Czar is defined by Webster's Dictionary, as 1. A former Russian emperor. 2. An autocrat. 3. Informal. One in authority: Leader. From these definitions we know that a Drug Czar is not one to listen to any opposition. Is this the basis of democracy?

The most infamous American Drug Czars include: William Bennet (a tobacco smoker, alcohol drinker and compulsive gambler) General Barry McCaffrey (the most decorated US General and instigator of failed "anti-cannabis media propaganda"), and John Walters (a career bureaucrat who labels peaceful cannabis consumers as terrorists). All past and present Drug Czars profess "high moral standards."

Many official Government and private reports have recommended legalization or decriminalization of cannabis including:

1928: Le Dain Commission (Canada) recommended to decriminalize or legalize small amounts of marijuana.

1972: the Safer Commission, appointed by President Nixon, reported that laws regarding marijuana should be decriminalized. Nixon rejected that recommendation, and instead endorsed the creation of the US Drug Enforcement Agency (DEA).

1990: California Advisory Panel (appointed by the State of California) recommended that California legalize marijuana. State Attorney General John Van de Kamp refused to publish the report.

2005: The Budgetary Implications of Marijuana Prohibition report is released. The Harvard University report by 500 US economists headed by economist Milton Friedman endorses legalizing and taxing cannabis.

Cannabis has been used medicinally for more than 10,000 years. Cannabis is being legally dispensed medicinally in 10 US states, Canada, the Netherlands and Spain. Still the US Government classifies cannabis as a Schedule I drug along with heroin as having no medical value.

The July 30, 2004 edition of the *Seattle Times* reported "Marijuana smuggling case first local use of Patriot Act provision. The US attorney in Seattle, WA charged 15 people in a marijuana smuggling operation. The undercover snitch, a U.S. Immigration and Customs Enforcement agent, posed as a middle man who actually smuggled money from the US to Canada.

The alleged cannabis and money smugglers were charged under the Patriot Act. The Patriot Act was passed into law in the US in order to thwart international terrorism after the September 11 attacks on the World Trade Center towers in New York City. However according to US attorney Todd Greenberg in Seattle, "there is no indication these defendants are connected to terrorism."

Here are a few well documented facts:

Cause of Death	Annual Deaths
Tobacco	435,000
Poor Diet and Physical Inactivity	365,000
Alcohol	85,000
Microbial Agents	5,000
Toxic Agents	55,000
Motor Vehicle Crashes	26,347
Adverse Reactions to Prescription Drugs	32,000
Suicide	30,622
Incidents Involving Firearms	29,000
Homicide	20,308
Sexual Behaviors	20,000
All Illicit Drug Use, Direct and Indirect	17,000
Non-Steroidal Anti-Inflammatory Drugs Such as Aspirin	7,600
Marijuana	0

This confirmed information for the year 2000 in the USA is from: <http://www.drugwarfacts.org/causes.htm> .

DRUG WAR FACTS

"A valuable resource for anyone concerned with drug policy."
— Ira Rosen, Senior Producer, ABC News

"A compendium of facts that fly in the face of accepted wisdom."
— David F. Duncan, Clinical Associate Professor, Brown University Medical School

Last updated April 27, 2005.
The full-sized 4th edition of Drug War Facts is available by [clicking here](#).

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YEAR	MARIJUANA ARRESTS
2001	723,627
2000	734,498
1999	704,812
1998	682,885
1997	695,200
1996	641,642
1995	588,963
1994	499,122
1993	380,689
1992	342,314

88.6 percent of arrests in 2001 were for possession only.

With ever increasing prohibition we are growing more cannabis around the world than ever before. Most of the photographs and much of the information was collected outside of the USA. The cannabis laws in the "Land of the Free" are some of the most horrifying and repressive

in the world. However, with the artificial "cannabis price support program in a free market" spawned by the US government, the rest of the world is benefiting. Growers from all over the world, including the ones that are willing to risk their freedom and assets in the USA, are able to cash in on this defacto program.

Here is how the program works. Cannabis is illegal. This creates an artificially high price for cannabis because the supply is limited and the demand high. Aggressive entrepreneurs see the opportunity and fill the need in the marketplace. When harsh laws are enforced, entrepreneurs give way to thugs and organized crime who fill the orders for cannabis. Any first year economics student can figure this out!

This information has caught the eye of a few politicians. A growing number of politicians are finding the integrity and moxie required to risk "political suicide" and endorse medical cannabis.

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The Indoor/Outdoor
Medical Grower's Bible
— by Jorge Cervantes

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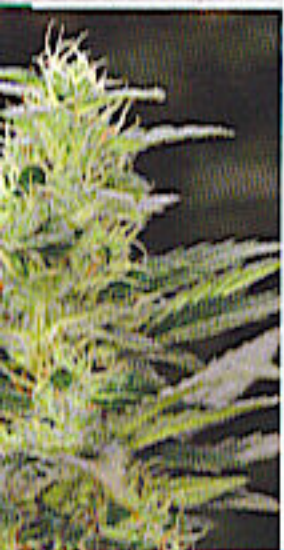
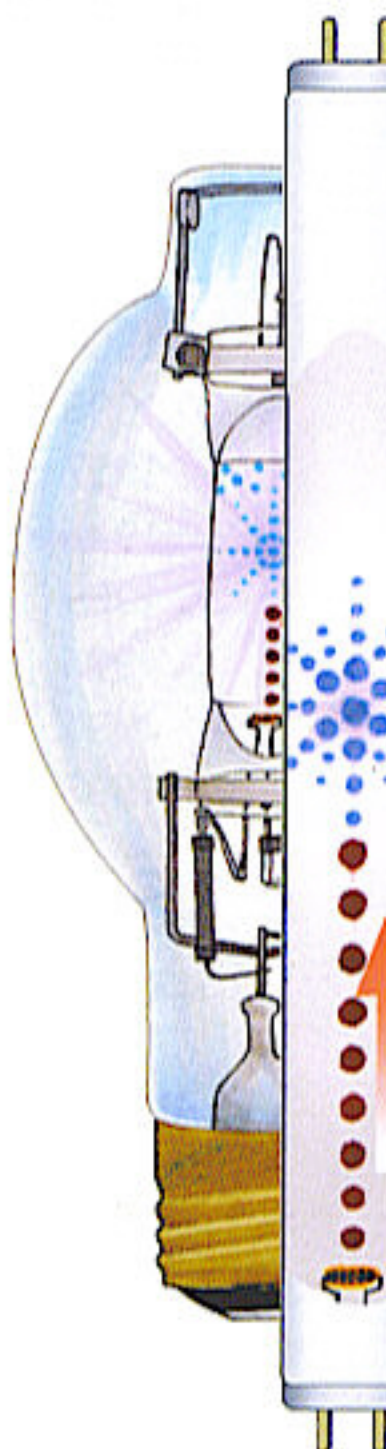
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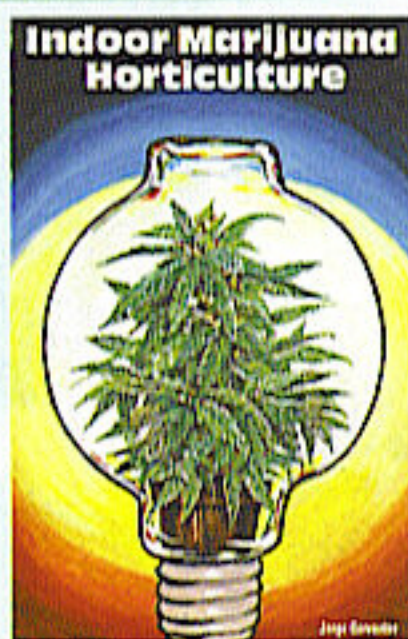




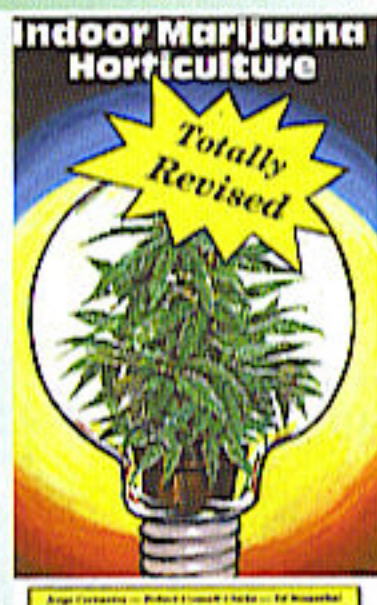
The book covers below are some of the many published by Jorge.



Original Indoor Marijuana Horticulture 1983



Indoor Marijuana Horticulture Second Edition



IMH Second Edition Revised

Introduction

The "Bible" has gone through a complete metamorphosis since the first edition in 1983. The First Edition was just 96 pages, black and white and bound with a pair of staples. I wrote the book on a Kaypro II computer. To typeset I hooked my Kaypro to a VAX mainframe computer. The typeset "galley" were pasted up into "hard copy." I printed the book on a Multilith press. My wife and I collated pages and stapled them together to form the first *Indoor Marijuana Horticulture* book. The book immediately became a best seller among indoor growers and has remained on top ever since!

The Second Edition (1985) grew to 288 pages and was christened "The Bible" by indoor growers. The Third Edition (1993) grew to 320 pages and the Fourth Edition (2001) tipped the scales at 432 pages and contained 200 color photos and drawings. The Bible is published in Dutch, German, French, English, and Spanish. There is also a special UK Edition. The Australian Edition was banned by the Australian Government, but lofty Aussies still find ways to bring in the Bible.

The Bible now has a little larger format (6 x 8.25 inches [150 x 210 cm]), 512 pages and is full color throughout with more than 1100 full color photographs, drawings, charts, and graphs. The Fifth Edition is completely rewritten to reflect the changes in cannabis cultivation in recent years. Sections on seeds, seedlings, vegetative growth, cloning, flowering, breeding and hash have been amplified substantially. All new sections have been added on greenhouses and outdoor growing. Photos and precise color drawings augment text to simplify information so that it is easier to assimilate.

Digital cameras, fast computers with big hard disks and fast Internet connections have transformed the Bible into a much more complete work.

We were able to hold the price at \$21.95 from 1993 until 2005, 12 years. The expense of adding color to each and every page, hiring editors, travel, office overhead, and inflation have made it necessary to sell a minimum of advertising as well as increase the price to \$24.95.

If you would like to learn more about advertising in the Bible, please hit our website: www.marijuanagrowing.com.

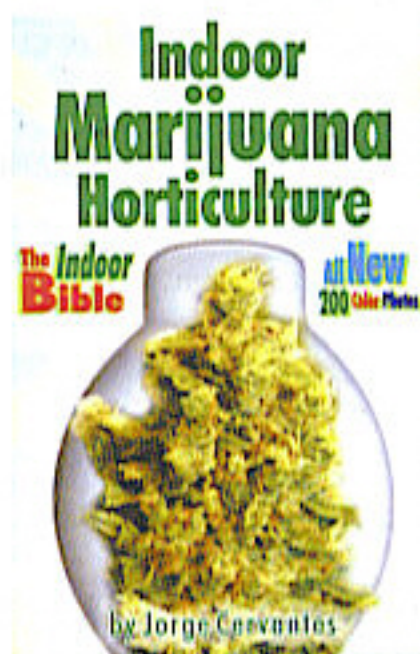
Case studies follow the text. They show exactly how different growers grew super smoke for pennies a day. All of their growing statistics - watts, varieties, calendar, cost, harvest weight, etc. - are also listed. See how growers invest a minimum of cash and harvest pound after pound of outstanding bud 365 days a year!

A garden "Calendar" and "Checklist" in the book lend additional organization for all indoor horticulturists.

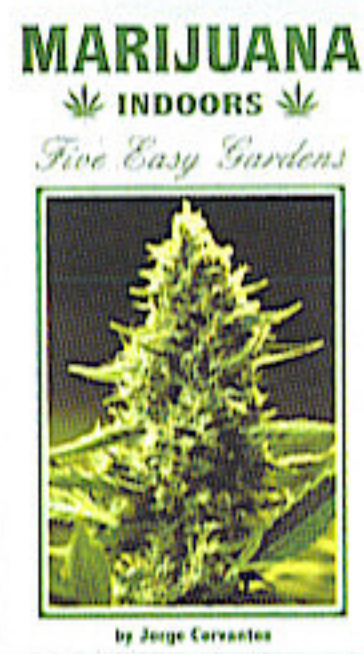
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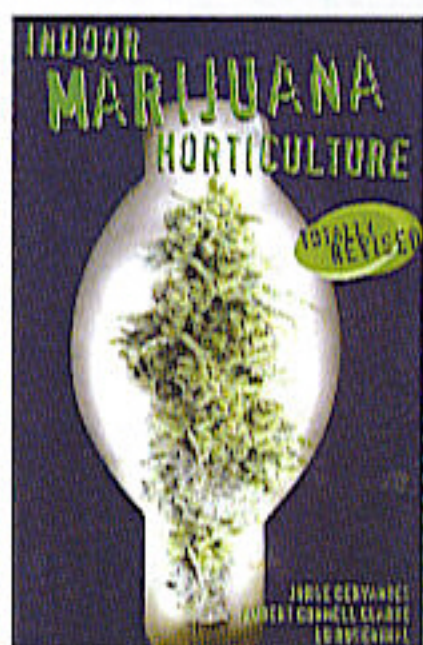
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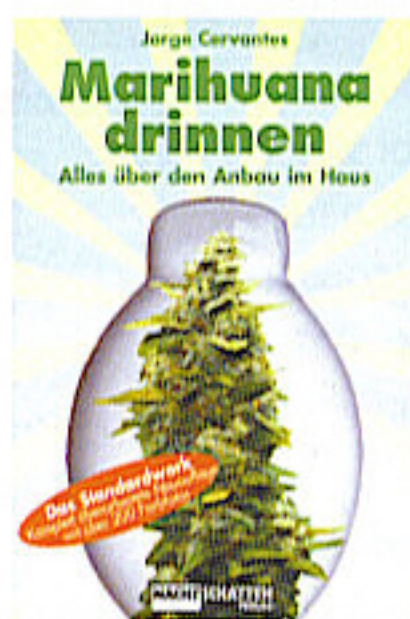
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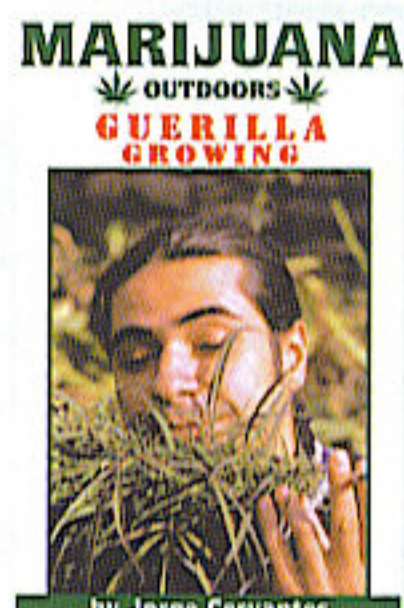
Marijuana Indoors:
Five Easy Gardens



IMH Third Edition



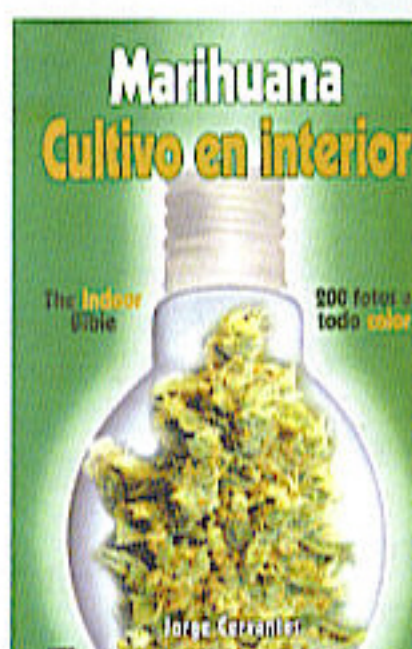
IMH Fourth Edition German



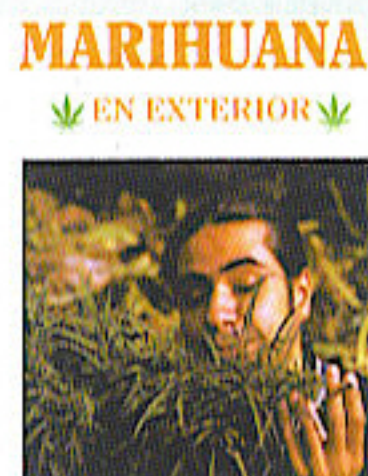
Marijuana Outdoors:
Guerilla Growing



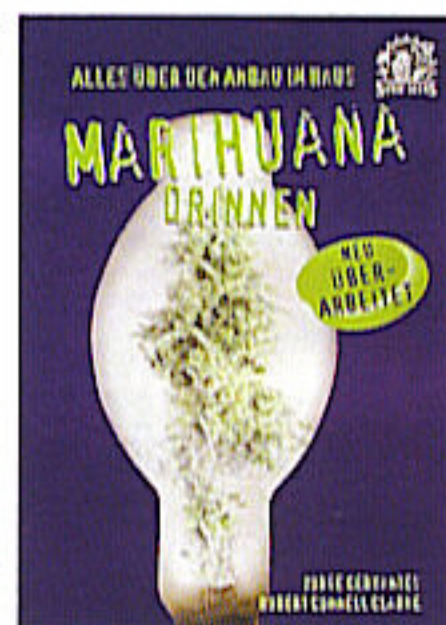
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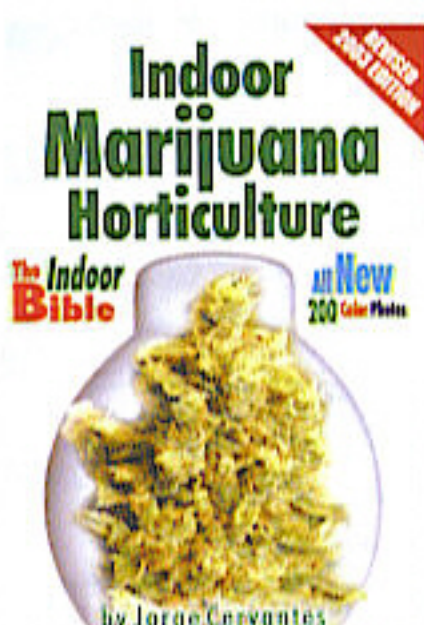
IMH Fourth Edition Spanish



CULTIVO DE GUERRILLA
Marijuana Outdoors:
Guerilla Growing -
Spanish Edition



Marihuana Drinnen



IMH Fourth Edition UK



Marijuana Jorge's Rx

The Internet

Grow Info FREE!

Information and velocity at which it travels is the most important new innovation in marijuana growing during the last five years.

The Internet allows millions of growers all over the world to share information. US growers can still ask and answer anonymous grow questions on line and download information about cannabis use. Here is a short list of some of my favorite web sites.

1. www.cannabiscafe.com is a very cool site! A couple of Chicano programmer aficionados from LA set up this site that is run by a consortium of Spaniards and latins. They also throw the Cannabis Parade in Asturias, Spain every year.



2. www.cannabisculture.com is the website for Cannabis Culture magazine. It has a full array of cannabis information including a good deal



about cultivation. Highlights include current and recent news.

3. www.cannabisworld.com, is a must for the serious grower. This is an advanced cultivation site.



4. www.cannatrade.ch is the official site of the CannaTrade Fair held in Switzerland. This fair is one of my favorites in the world!



5. www.hightimes.com is the official High Times magazine site. This site has a full array of politics, news, cultivation and more! This very



MARIJUANA HORTICULTURE The Indoor/Outdoor MEDICAL GROWER'S BIBLE

high-traffic site has everything for the cannabis enthusiast. Put this site on your "Favorites" list

6. www.marijuanagrowing.com is Jorge Cervantes' official site. It is packed with current information on marijuana cultivation with pages and pages of up-to-date cultivation information, plus Jorge's articles and numerous tips on growing in today's world.



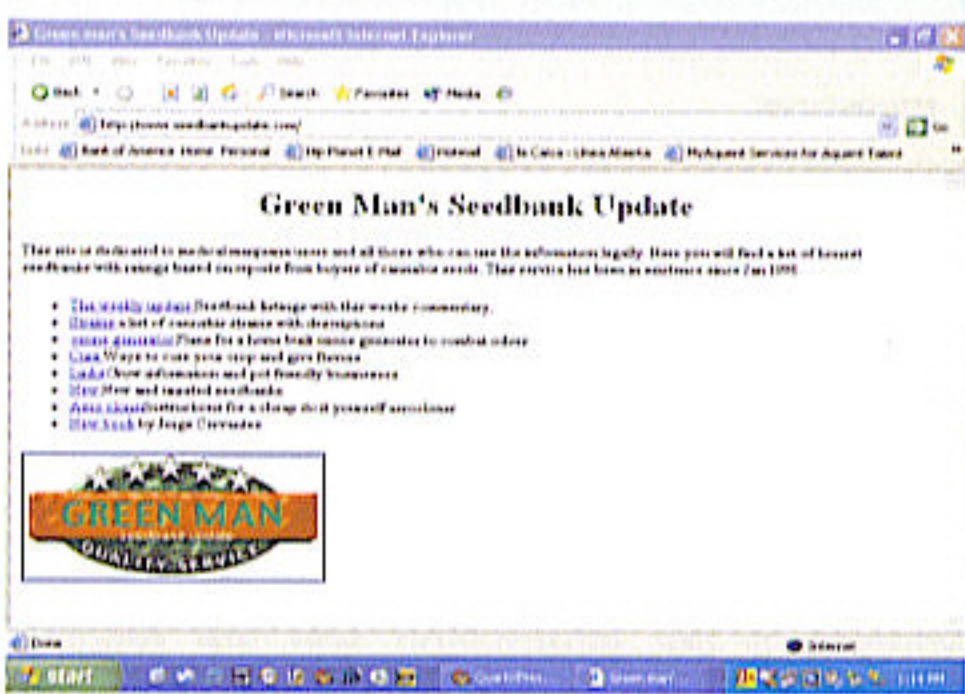
7. www.naturescontrol.com is not a cannabis site, but is packed with beneficial insect information



8. www.overgrow.com is the absolute best grow site on the Internet. It has everything! More than four million posts in the forums and 700,000 images of cannabis. The "StrainGuide" lists more than 1000 cannabis varieties produced by more than 75 breeders that sell to the public. Also featured are hundreds of personal synopses about growing specific varieties-by the growers themselves!



9. www.seedbankupdate.com rates seed companies with the most reliable information on the Internet. This outstanding site is updated weekly.



10. www.solocannabis.com This Spanish site has the biggest member base and the most hits of any Spanish language site-definitely the biggest site in the Spanish language. This site is run by a dedicated cannabis aficionado and good friend from a small town in Northeastern Spain.



The Internet was developed by the DOD (Department of Defense) in the latter half of the 20th century. Government geeks and spooks developed the World Wide Web for national security reasons. It is easy to set up a proxy server along with a few other safety precautions to surf with safety so the government cannot track your every move.

Be very careful when surfing the Internet. Check out www.overgrow.com for more information about surfing safely.

Smart growers, especially from countries with draconian laws, do not e-mail about growing or surf grow sites on a computer located in a grow house. Remember, a person never knows who is peeking at transparent e-mail. "Firewall" software alerts and protects the user against another party tracking a surfing path or to unauthorized entry into their computer. Ask at your local software store for security software to keep unwanted computer spooks subdued.

Check out the FAQs on www.overgrow.com for a complete rundown on Internet security.

Do not frequent marijuana sites or talk shop on the net unless you have taken appropriate security measures.

Internet information can be great or it can be packed with problems. All growers and "authorities" have the same status on the Internet, and can post "facts" to their site or news group. Many times unverified, poorly researched "facts" are either self-serving or untrue. Always ask yourself if the information you are reading makes sense. If it sounds too good to be true, it probably is. I often surf through many sites and pages before finding something worth retaining. "Free" often means the material is sales oriented. News groups provide an excellent forum to share grow stories.

Marijuana Chemistry

Cannabis is the only plant that produces chemicals called cannabinoids. However, with gene splicing and genetic engineering, it is only a matter of time until cannabinoids are added to other plants. Cannabinoids are ingredients unique to cannabis; the psychoactive cannabinoids are responsible for the mind-bending effects of marijuana. Some cannabinoids get you high. Around 40 cannabinoids have been confirmed to exist, but most are not psychoactive. Here is a short rundown on the six most prominent cannabinoids.

Δ^9 THC, the main ingredient that gets you high, is called: Δ^9 -trans-tetrahydrocannabinol. All cannabis, whether industrial hemp or drug marijuana, contains some Δ^9 THC. Industrial hemp cannabis contains infinitesimal amounts while dried flower tops (buds) of potent marijuana can contain up to 25 percent Δ^9 THC. In potent varieties of marijuana, perhaps all of the mind-bending effects are derived from Δ^9 THC.

Δ^8 THC is found in very low concentrations in cannabis. It also gets you high, but there is so little Δ^8 THC in most cannabis that researchers, breeders, and growers concentrate on the more abundant and potent Δ^9 THC. To simplify matters we will refer to both Δ^9 THC and Δ^8 THC as THC.

Cannabidiol, known as CBD, also appears in virtually all varieties of cannabis. The amount of CBD varies enormously, from a trace to more than 95 percent of all cannabinoids present in a plant. CBD generally has a sedative effect regarding the high you experience. CBD, when combined with THC, tends to postpone the beginning of the high, but the good part is that CBD can make it last twice as long. Whether CBD increases or decreases the force of the high is subjective and must be discerned by each smoker.

receptors and neurotransmitters. Some terpenoids act as serotonin uptake inhibitors (as does Prozac®), and augment the neurotransmitter GABA (as does Valium). Terpenoids produce anti-inflammatory effects in the respiratory tract. Their presence in marijuana smoke may explain why inhaling marijuana smoke causes less airway irritation and inflammation than inhaling pure THC. Limonene blocks the carcinogenesis induced by "tar" generated from the combustion of herb. Limonene is currently undergoing tests for the treatment of several types of cancer. Terpenoids rock.

Dr. Ethan Russo described "endocannabinoid deficiency syndrome," and suggested that the administration of THC and CBD corrected for deficiencies of either anandamide or CB receptors. The administration of THC and CBD seems to kick-start our endocannabinoid system. For example, THC stimulates the release of anandamide, and CBD inhibits the breakdown of anandamide. One study has shown that acute administration of THC may increase the density of CB receptors in the central nervous system. Tolerance and addiction to marijuana is uncommon, in part, because THC is a "partial agonist." Agonists are compounds that stimulate receptors, and partial agonists can only partially activate receptors. Perhaps the best medicines are partial agonists—they steer us away from disease, but our innate healing mechanisms are still required to restore us to complete health. We recall the sheep farmer analogy: when the farmer finds a sheep on the wrong side of the fence, the farmer corrects the situation by placing the sheep on the other side of the fence, not by carrying the sheep over the fence and all the way to the center of the pasture.

In conclusion, marijuana as medicine is becoming accepted around the world, even among scientists and physicians. Professor John Graham was not far off when he predicted in 1976, "The drug has been frowned upon, officially banned, but the interest of the medical profession is slowly reviving. It is not impossible

that a limited but respectable niche will be established for it in therapeutics by the end of the century" (*Marijuana and Health*, by J. D. P. Graham, Academic Press, 1976).

For regular updates on the "Science, Politics and Law" surrounding medical marijuana, subscribe to *O'Shaughnessy's - the Journal of Cannabis in Clinical Practice* (www.ccrmg.org/journal.html).

More Information on Medical Marijuana

Visit www.marijuanagrowing.com or any of these other web sites:



1. www.drugpolicy.org/marijuana/medical/

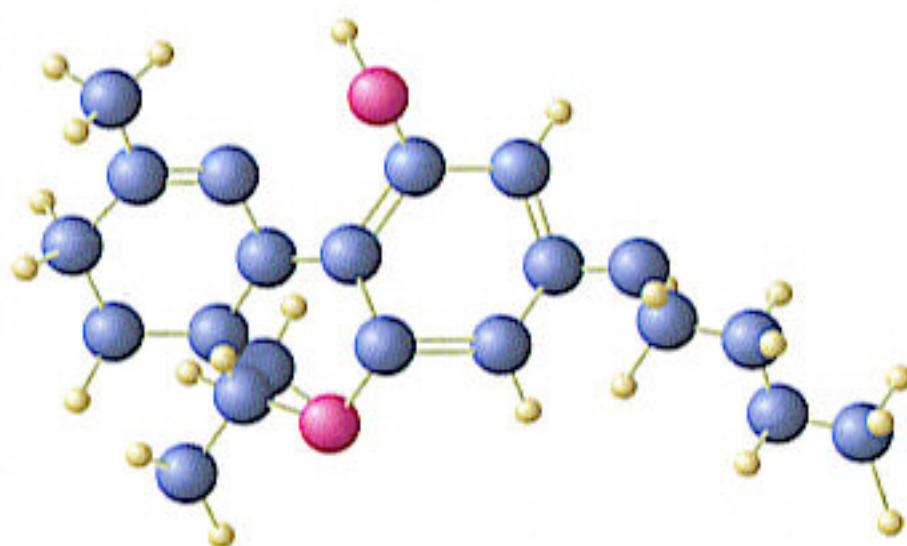


www.americanmarijuana.org

Cannabinol, or CBN, is produced as THC oxidizes or degrades. Only a trace of CBN exists in fresh bud. Stored and cured tops or hashish have higher levels of CBN, that has converted from THC. Marijuana with high levels of CBN generally makes the toker feel disoriented, often sleepy or groggy, referred to as a stupefying high. At best, CBN contains only 10 percent of the psychoactive potency of the original THC.

Tetrahydrocannabivarin, called THCV, is the shorter three-carbon propyl that replaces the five-carbon pentyl chain. This compound is associated with the fragrance of the plant. In other words, very pungent smelling marijuana normally contains THCV. Warmer temperatures bring out more smell. THCV is found in very potent marijuana that originates in Southeast and Central Asia as well as regions in Africa. Concentrations of THCV usually make the high come on quicker and disappear sooner. There is still much research to do on this cannabinoid.

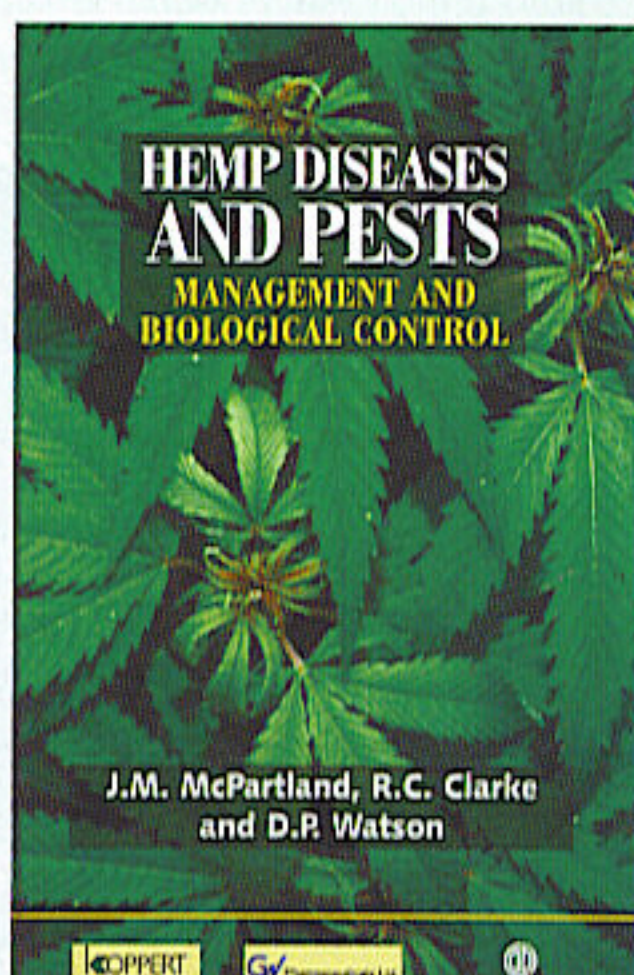
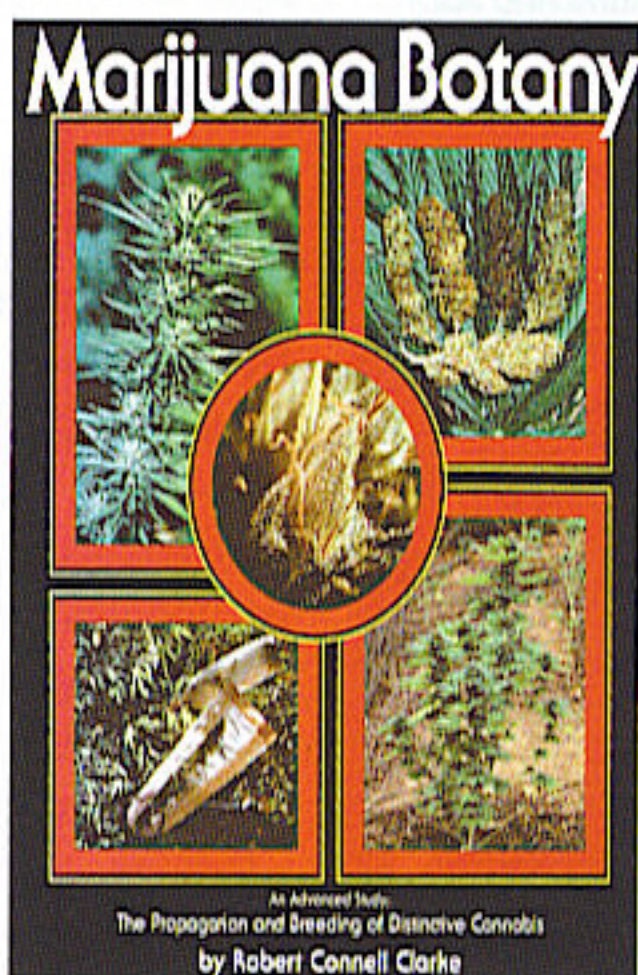
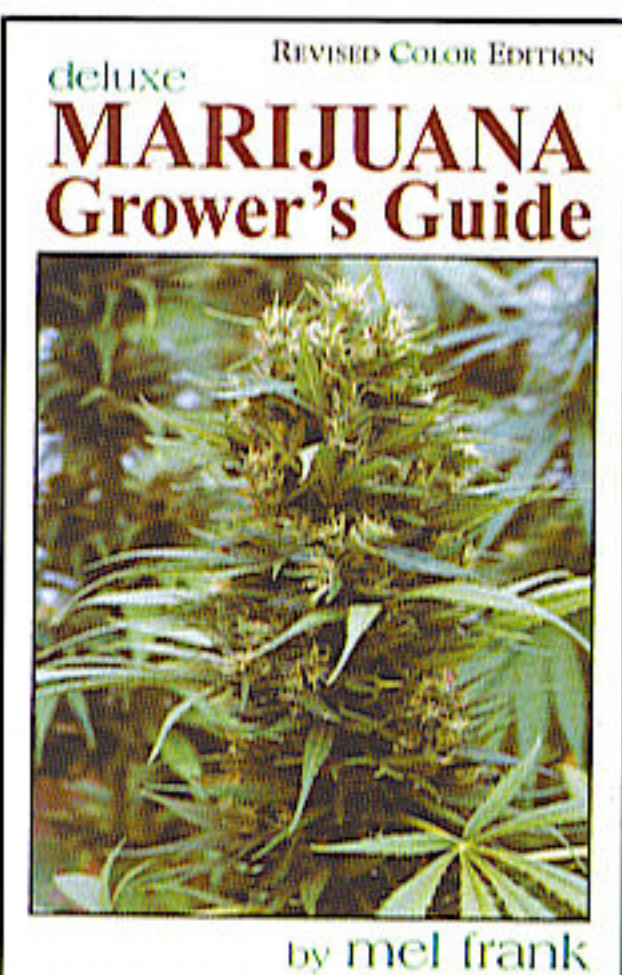
Cannabichromene, or CBC, may make up to



Here is a look at a THC molecule.

20 percent of the cannabinoid profile in a plant. Little study has been done on this cannabinoid. So far, researchers believe it may interact with THC to make the high more intense.

For a complete background on cannabinoids, including chemical diagrams, resin profiles, and production of cannabinoids, see the classic book, *Marijuana Grower's Guide*, by Mel Frank, Redeye Press, 1997, 330 pages.



Three excellent reference books that all indoor marijuana horticulturists should have on hand are: the *Marijuana Grower's Guide*, by Mel Frank (Redeye Press), *Marijuana Botany*, by Robert Connell Clarke (Ronin Press), and *Hemp Diseases and Pests* by J. M. McPartland, R. C. Clarke and D. P. Watson (CABI Publishing). The books are classic cultivation and breeding guides. For more valuable background information on gardening, read some of the 20 magazines we list in the back of this book; and hit the Internet sites listed in this chapter. You may also want to attend some of the cannabis fairs listed in the Introduction. Also, read such publications as *Organic Gardening*, *Sunset*, *Mother Earth News*, etc., and the gardening section of your local newspaper.



The Reverend Charles Eddy Lepp of Eddy's Medicinal Gardens and Multi-Denominational Ministry of Cannabis and Rastafari.



Tgranne and Mishka of Mama Productions and Jack Herrer (The Emperor Wears No Clothes) enjoy a moment at the Cannabis Cup in Amsterdam.



Lorna, director of the Cannabis College in Amsterdam, educates thousands every year about the proper use and benefits of medical marijunana and cannabis.

Marijuana as Medicine

by Dr. John McPartland

Cannabis (marijuana, hashish) has long been used for recreational and medicinal purposes—for 10,000 years or more. Its medical indications are manifold, including glaucoma, muscle spasticity (e.g., multiple sclerosis), movement disorders (e.g., Huntington's disease), and a variety of pain syndromes. Marijuana reduces nausea and vomiting and enhances appetite, so it helps people with AIDS and opposes the side effects of cancer chemotherapy. Research shows it can prevent the death of injured neurons. And everyone knows it alleviates anxiety and depression.

Marijuana research is one of the fastest-moving fields of medical science, so any books we suggest may soon be outdated. In the 2000 edition of *Indoor Marijuana Horticulture*, we recommended the book *Marijuana and Medicine* (National Academy Press, 1999). This classic book has been updated by *Cannabis and Cannabinoids* (Haworth Press, 2002) and *The Medicinal Uses of Cannabis and Cannabinoids* (Pharmaceutical Press, 2004). *Marijuana Medicine* by Christian Rätsch (Healing Arts Press, 1998) is a beautiful book that focuses on ethnobotany and the historical uses of cannabis. Notable web sites include www.maps.org, www.medicalmj.org, www.medmjscience.org, and links posted at www.druglibrary.org/schaffer/hemp/medical/medical.htm. For regular updates on the "Science, Politics and Law" surrounding medical marijuana, subscribe to O'Shaughnessy's - *The Journal of Cannabis in Clinical Practice* (www.ccrmg.org/journal.html).

Despite marijuana's unambiguous medical benefits, the USA Drug Enforcement Administration (DEA) classifies marijuana as a prohibited Schedule 1 drug ("no currently accepted medical use"). However, tetrahydrocannabinol (THC), the primary active ingredient in marijuana, is classified as a synthetic Schedule III drug (dronabinol, Marinol®). The DEA's hypocritical classification is rejected by

many Americans. Currently ten states in the USA allow patients to possess marijuana for medical use, contingent upon a physician's recommendation, but possession remains illegal under Federal law.

Because marijuana remains illegal under Federal law, its source remains the black market. Patients must obtain their medicine from unregulated producers. You, dear reader, may be one such unregulated producer. Patients depend upon your ethics and expertise to supply them with high-quality medicine, free from contaminants. Jorge and I reckon that dishonorable laws create honor among outlaws, so we entreat all growers to supply only the best organically grown marijuana. The methods for cultivating pharmaceutical-grade herb are outlined in this book. Grow the healthiest plants possible, by paying careful attention to the basics: light, nutrients, water, and air. Everything must be in balance, especially nutrients. If you get the balance right, you won't need to read the chapters on insect and mold control. The most common contaminants of marijuana are molds or pesticides. Optimal cultivation eliminates the possibility of these contaminants.

Of course, optimal cultivation may sometimes elude even the best grower. This book details the use of natural pesticides such as oils and soaps. Better yet, this book promotes the use of biocontrols—commercially available organisms that combat pests and diseases (ladybugs versus aphids being a classic example). For more information regarding the use of natural pesticides and biocontrols, consult the "bible," *Hemp Diseases and Pests* (see sidebar). Despite all this great information, we still preach the bottom line: "An ounce of prevention is worth a pound of cure." Even "natural" chemicals may cause problems in some people. The latest edition of O'Shaughnessy's details the case of a woman who fell ill while manicuring marijuana that had been sprayed with abamectin. Abamectin is a natural compound produced by a soil bacterium. It is approved for use in organic gardens, but, nevertheless, it nearly killed the



This medical marijuana patient is tending a garden while seated in a wheelchair. Gardening can produce a patient's medicine and provide therapy.

woman. Grow well and avoid chemicals.

So how does marijuana work as medicine? The question is a proverbial onion, with many layers to peel before we get to the core. The first layer is the medicine's herbal essence, which is at odds with current medical science. The DEA and FDA criticize the use of herbs as medicines, saying plants contain a variable mix of compounds and cannot provide a precisely defined drug effect. According to the pharmaceutical industry, medicines are synthetic, single-ingredient "silver bullets" that focus upon solitary metabolic pathways in our physiological systems. Herbalists, on the other hand, applaud the polypharmacy of herbal remedies, and claim two advantages over single-ingredient drugs:

1. The many constituents in herbs may work by multiple mechanisms to improve therapeutic activity in a cumulative or synergistic manner.

2. Herbs may also contain compounds that mitigate the side effects of their predominant active ingredients.

Thus, marijuana has been characterized as a "synergistic shotgun," in contrast with synthetic, single-ingredient "silver bullets." The many ingredients in marijuana modulate our health via several metabolic pathways, gently nudging our system towards homeostasis. According to the pharmaceutical industry, This kind of "multi-tasking" makes marijuana impossible to evaluate, according to the pharmaceutical industry. But multi-tasking avoids the unbalanced distortion of solitary metabolic pathways, as produced by synthetic, single-ingredient silver bullets such as Vioxx.

First and foremost in marijuana's list of ingredients is THC. Tetrahydrocannabinol (THC) is a "new" molecule, produced by cannabis, which evolved within the past 34 million years. Many botanists speculate that THC initially evolved as a toxin to deter herbivores. But this evolutionary strategy was diverted when THC became attractive to humans—the "botany of desire" described by Michael Pollan. THC works in humans by mimicking an endogenous compound that our own bodies make, called anandamide. THC binds to anandamide's receptors, called cannabinoid (CB) receptors. Research indicates that CB receptors originally evolved in primitive organisms about 600 million years ago! However, as with all chicken-and-egg questions, the story of CB receptors and cannabis began long before the current pair of protagonists appeared in evolutionary time. It is probable that both CB receptors and cannabis had evolutionary predecessors. They may date to "deep time," before plants and animals diverged in the primordial soup. Over many eons, CB receptors may have become "vestigial," analogous to an appendix, only to be reactivated when Homo sapiens discovered cannabis. Humans have interacted and coevolved with cannabis for millennia, creating a complex heterogenous medicine by selecting plants that provide maximal

benefits and minimal side effects. The success of 10,000 or more years of human refinement with this botanical medication will be difficult to replicate in modern laboratories. This deconstruction of pharmacological theory is radical, and may herald the re-introduction of herbal medicines into modern medical pharmacopeias, with marijuana leading the way.

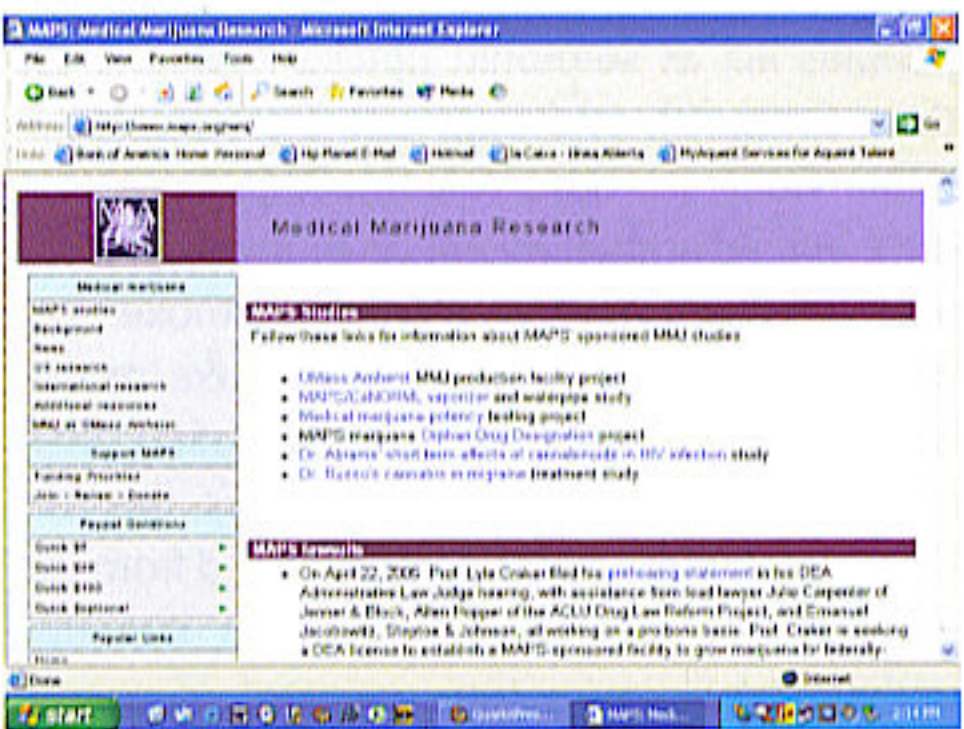
When THC or anandamide activate CB receptors, the CB receptors activate G-proteins. G-proteins are microscopic messengers that migrate around cells and modulate a variety of ion channels and enzymes. Cannabinoid receptors associate with different subtypes of G-proteins, such as Gi and Gs subtypes. The "i" and "s" abbreviate "inhibitor" and "stimulator," which describe the opposite effects these G-proteins have on their targets. Research has shown that different cannabinoids preferentially activate different subtypes of G-proteins. This may explain why different strains of marijuana produce different highs. For example, Afghani plants produce a lot of cannabidiol (CBD), and perhaps CBD preferentially activates Gi and causes an inhibitory, stony, narcotic-like effect. Whereas plants from Thailand contain tetrahydrocannabivarin (THCV, a propyl analogue of THC) that might preferentially activate Gs and cause that speedy, buzzy, Thai high.

Thanks to its mix of ingredients, marijuana causes fewer psychological side effects (such as anxiety and panic reactions) than pure, synthetic THC (Marinol). Clinical trials have shown that CBD reduces the anxiety provoked by THC, and CBD demonstrates antipsychotic effects. Anxiety from THC may also be alleviated by terpenoids present in marijuana. Many terpenoids are volatile and possess sedative properties when inhaled, including limonene, linalool, citronellol, and terpineol. Terpenoids may also mitigate memory loss caused by pure THC. Limonene, terpinene, carvacrol, and pulegone increase brain acetylcholine activity. This mechanism is shared by tacrine, a drug used for the treatment of Alzheimer's disease. Terpenoids act on other

MARIJUANA HORTICULTURE The Indoor/Outdoor MEDICAL GROWER'S BIBLE



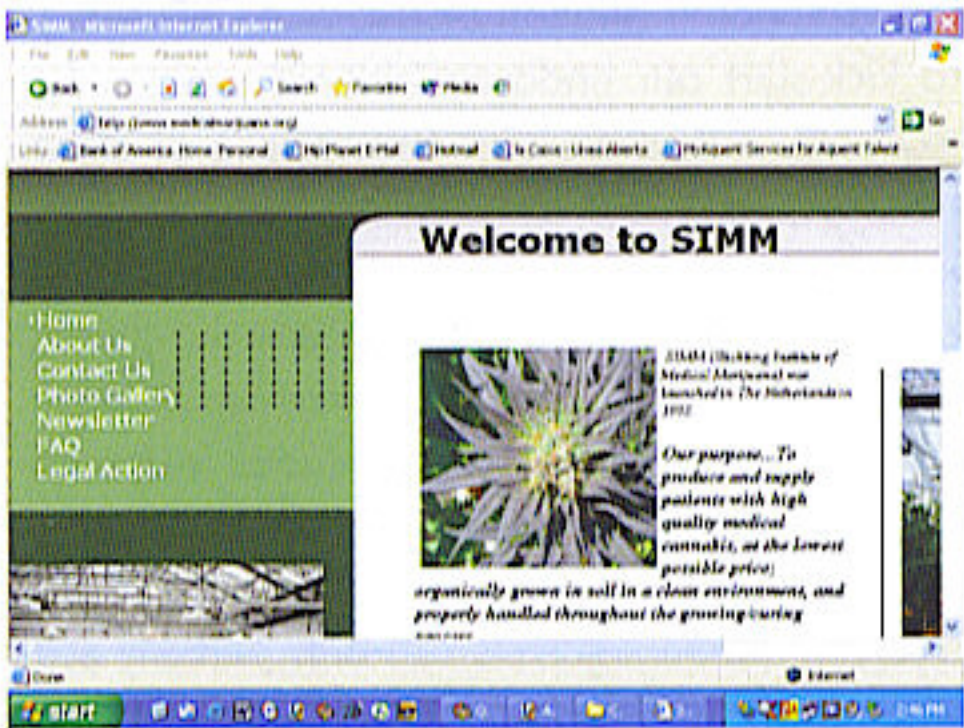
www.cannabislink.ca/



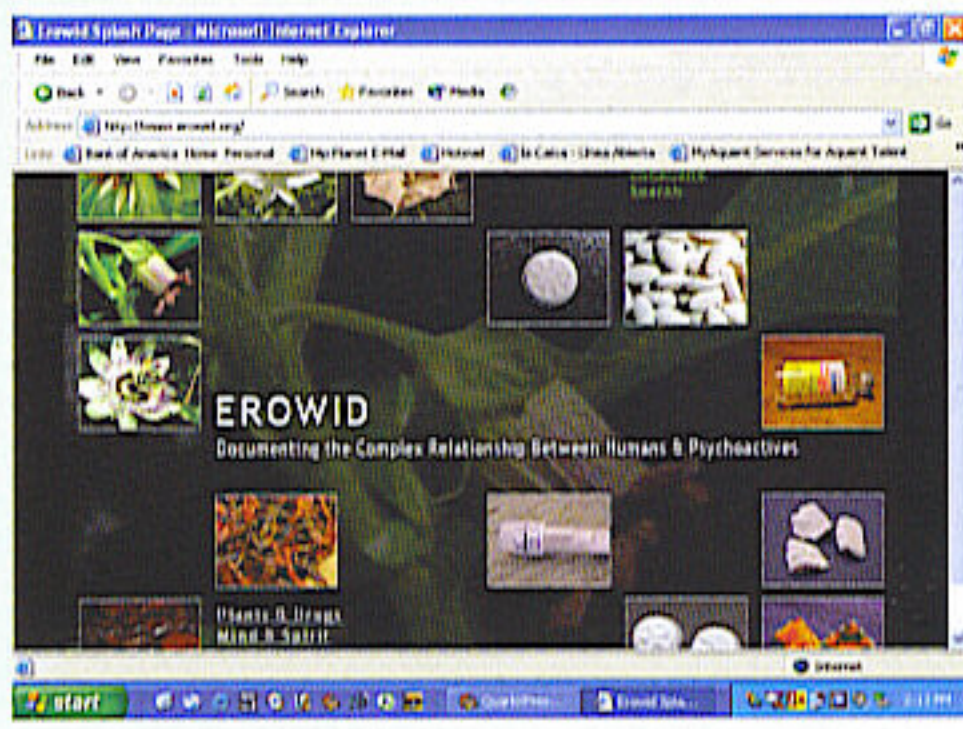
www.maps.org/mmj



www.crrh.org



www.medicalmarijuana.org



www.erowid.org



www.medmjscience.org



www.thecompassionclub.org



www.wamm.org

Safety and Security!

Unfortunately we must include a security chapter in this book. You must keep your crop secure from police and thieves alike. Ironically, the police will cause you more problems than thieves!

Successful indoor growers are good citizens and keep a low profile. They keep the yard and home clean and in excellent repair. They always drive a street-legal car and there are no outstanding warrants on the drivers. Remember, an overdue traffic ticket turns into a warrant for the violator's arrest. Smart growers pay bills on time, are nice to neighbors, and do not throw noisy, wild, crazy parties.

Do not throw out any garbage that could prove that you grow. Cops pick through it like rats to find evidence to make a case against gardeners. Growers live by the motto "loose lips sink ships."

Never have seeds or grow products sent directly to your home.

Growers and tokers have been made into "the enemy" by the American government in the War on Drugs. It is the job of law enforcement to arrest the flower-growing enemy. To wage this war on US citizens, law enforcement wields an impressive arsenal, including draconian laws, misinformation and high-tech surveillance gizmos.

The cardinal rule of growing is: Never tell anybody about any garden.

Clandestine growing is as simple as the name implies. The name of the game is secrecy. Tell nobody and cause no suspicion. Countless underground growers have been harvesting crop after crop for decades in Drug War-torn America. These benevolent souls supply much of America today.

Stay away from other grow houses, wild parties, real criminals, etc. Always take a friend's car to the grow store and go seldom. Travel with others whenever possible. Your car is easy to trace and follow. Keep your consumption habits reasonable; don't show large cash income. Buy large assets, houses and cars, over time. Don't ever tell anybody you are growing or even joke about growing. Always have a job and a reason for your activities. Keep a low profile.

Keep your home and surrounding property in good repair. Make sure the house is painted, lawn mowed, and garbage picked up. Keep electrical use to a reasonable amount, and keep the air clean around the house. Have very few visitors, and keep to yourself. Have minimal conversations with neighbors.

Never trust anybody—friends, family—brother, sister, children, even your mother! In America, "Land of the Free," a grower can go to jail just for giving another grower advice! The Racketeer



A guard dog is one of the best deterrents against thieves.

Influenced and Corrupt Organizations [Act] (RICO) conspiracy laws were enacted to break up the Mafia. Today RICO laws are used against growers and non-growers alike. Under the law, a person that advises a grower to "water in the morning" is equally guilty of growing the marijuana garden, even if he never saw the garden. RICO laws tread on the very essence of the American Constitution.

The new Homeland Security Act further erodes personal rights of individuals.

Never visit or telephone other growers. If visiting another grow room, that grower can implicate you with circumstantial evidence, and you are considered as guilty as the grower!

DO NOT use booby traps, bear traps, firearms attached to tripwires, etc., to protect your crop

I know of people who use infrared systems that take pictures and/or start recording video when an object of particular size/temperature enters the vicinity.

Depending upon the country in which you live, law enforcement must first have a search warrant to use infrared or thermo imaging devices to secure a search warrant. But if they have a search warrant, such high-tech snooping is perfectly legal. If you want to take a look at what they see, rent heat-sensitive night-vision glasses

from your local military supply store, or take a photo of the outside of your grow operation with infrared film. You can also add a filter to your digital camera and convert the fotos with a few clicks of Photoshop to show heat signatures.

Law enforcement has sophisticated telephone bugging devices, super-sensitive directional microphones, infrared scopes, thermal imaging, etc. They can also subpoena telephone, Internet, and electrical company records. Intimidating cops coerce electric company employees to break the law and give them the records of unsuspecting consumers. Tracking telephone numbers, including location, is very easy. There has been more than one case where US law enforcement illegally acquired telephone records and placed illegal taps on garden store telephones. American police use telephone records to target grow houses. Always use pay telephones with an untraceable phone card or pay with coins. Lazy narcs also watch garden store parking lots and follow clients home.

Pay all bills and make all purchases with cash. Cash tells no tales and leaves no trails. Pay for mail order merchandise with a money order. Have the merchandise sent to a "safe" address.

If you want to take photos of your garden, use

a digital camera. Using an old-fashioned film camera, you risk discovery when getting the film developed.

Growers who cultivate cannabis, including medical cannabis, should never show their grow show to anyone! Never tell anyone you are growing. Deny growing to everyone, always! You immediately change from a Weed Warrior to a helpless victim subject to extortion the instant anybody knows you are growing in the USA. When the cops arrest a "friend" that has seen your grow show, they can legally use deception and intimidation to trick your "friend" into squealing on you. Beware! Interrogations can last for months!

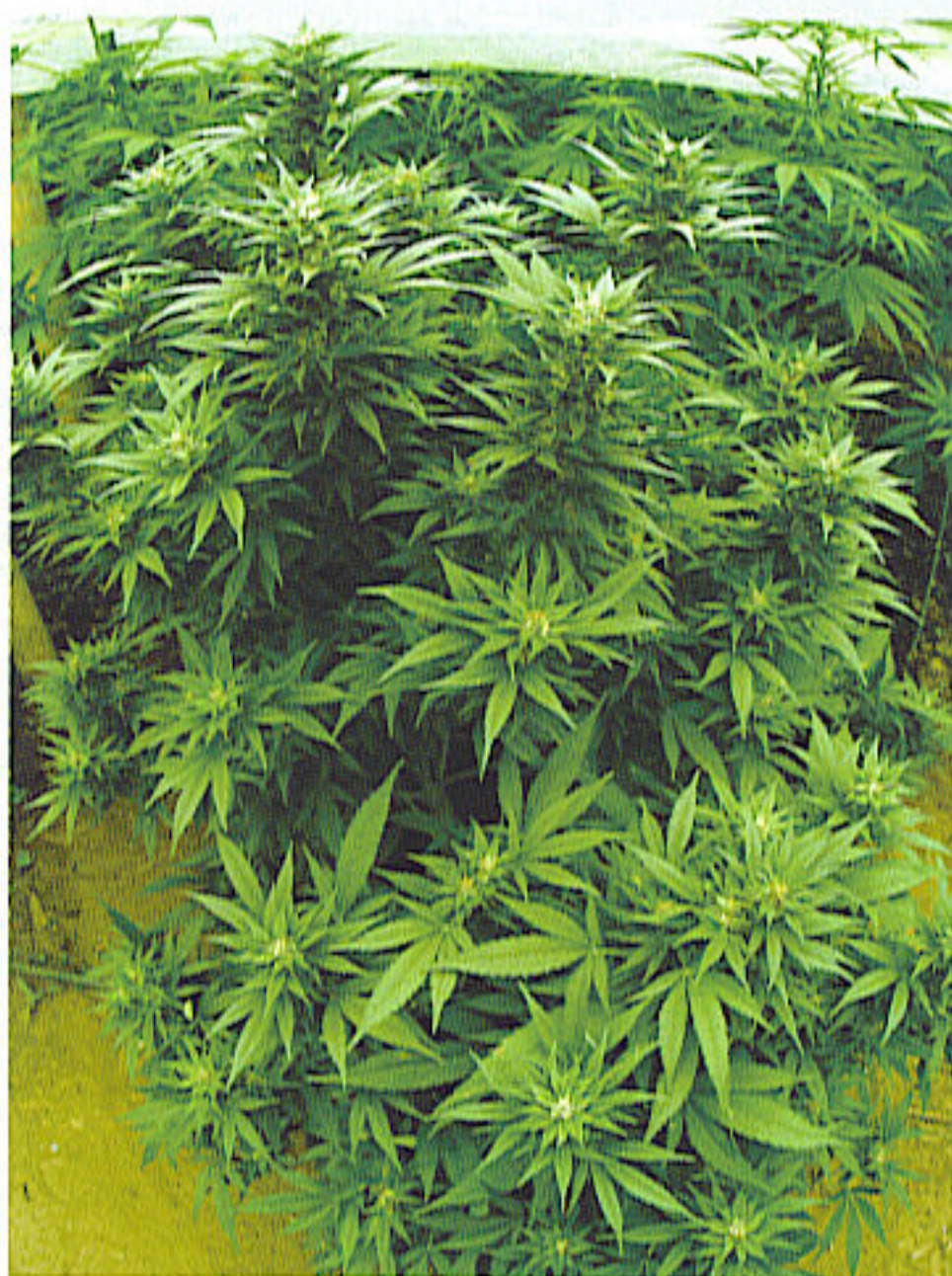
Law enforcement rewards jealous, hateful, and vindictive "friends," lovers, and enemies for implicating a grower under the RICO laws and Homeland Security Act. Hundreds of thousands of growers have had their lives ruined in a matter of moments on testimony from a vindictive "friend."

All electrical outlets, fuses, and connections must be grounded. Inspect electrical connections for signs of heat-blackened wires, melted connections, and smelly wiring.

Have a current fire extinguisher rated to put out wood, paper, grease, oil, and electrical fires.

When law enforcement has "evidence" of a growing operation, they look for more. In the USA they look at telephone, electric, and shipping records, for starters. A thermal imaging camera is most often used at this point. Occasionally they use dogs trained to sniff out marijuana. The information is used against the grower to obtain a search warrant. If there are plants discovered at the house, they continue to build the case against the grower by using anything the grower says. The police collect most of the information on the grower from the grower!

Surround your property with a bed of cedar shavings instead of bark chips in the flowerbeds. Cedar shavings disguise other odors. Use a carbon filter and an ozone generator to neutralize the marijuana fragrance. Have a ready reason for



Cannabis indica plant with its characteristic broad leaf and short stature.

extra electrical consumption. Unload grow supplies a little bit at a time or from within a locked garage.

Remember the quote from Bart Simpson: "I didn't do it. Nobody saw me. You can't prove a thing!"

Absentee owners are the best landlords. Make sure home inspections are done before you move into the home and the rental agreement should allow for an advance notification of inspections. Put the telephone, electricity, garbage, etc., in a friend's name. Grow in a rented home. If you have bank accounts and stocks, own property such as a home, automobile, ATV, etc., in the USA, they are often forfeited if you are "suspected" of growing. You do not need to be convicted of any crime for your assets to be confiscated!

Curb noise and odors by sealing and insulating the grow room with "sound board." Similar to sheetrock, soundboard muffles sounds well. Install rubber feet or grommets on fan feet. Build an extra room or box (allow for air flow)

Security Checklist:

- Regular schedule
- Simple lifestyle
- Very little contact with neighbors
- Always be pleasant
- Never open the grow room door for anybody!
- Electric bill should be about the same as the neighbors and previous tenants
- Garden and grounds should be tidy and similar to neighbors
- No light leaks whatsoever
- Use friend's car to visit grow store
- No noise-humming, fan on/off at night, etc.- is audible day and night
- No strange odors, including ozone smell

around ballasts to muffle noise. Place a thick pad under ballasts to absorb vibrations. In-line fans are much quieter and more efficient than squirrel-cage blowers. If light escapes from vents, give venting a 90-degree turn and paint the vent black where it turns. This will eliminate unsightly light leaks. Ozone-treated air should discharge through a roof vent or chimney to decrease ground-level odors. See "Ozone



Keep air conditioner water from draining outside. The water is packed with potent cannabis fragrance.

Generators" in Chapter Thirteen. Be careful when installing a ceiling vent or when venting out chimney. Light shining out the chimney and around roof vents looks very suspicious!

"All electric" homes are few and far between. Electrical use information from previous tenants might be available from the electric company. On the average, growers in the USA can use one 1000-watt lamp per bedroom. This means a two bedroom home can host 2000 watts, a three bedroom home 3000 watts, etc. Unhook the dryer and other appliances that draw much electricity. Turn the water heater down to 120 degrees, and take showers at the gym.

Stealing power from the electric company causes even more exposure than paying for it! The extra risk is insane, and it's wrong to steal!

For more information on Internet, personal, and grow show safety, check out the cannabis grow sites listed earlier in this chapter.

Now, relatively inexpensive (less than \$10,000) thermal imaging devices are becoming more affordable for smaller police forces. Thermal imaging devices have been used legally to measure the heat signature escaping from structures. This invasive "evidence" is used with other "evidence" to secure a search warrant.

According to US police sources, the devices are legal only to find heat escaping from windows, vents, etc. Most often narcs use the cameras illegally to secure a search warrant. They slither around the neighborhood early in the morning or under the cloak of darkness to snap the hot shots. The law stipulates specific parameters for the camera, and the technology is relatively arcane. The "approved" imaging devices are able to record differences in heat levels outside of buildings. In the USA, it is illegal to search the inside of a structure for the "heat signature.". However, today there are devices that can actually "see through walls" to provide an image based on the heat a person emits.

Avoid thermal imaging problems by turning grow lights on during the daytime. The daytime heat and light make accurate measurement of

heat coming from vents and windows impossible. Thermal imaging cameras are rendered useless; the technology will not work during the daytime. Shield and insulate walls and windows from heat loss from lamps. Store ballasts in separate rooms, and channel the heat away from the grow room. Cool grow room air before exhausting outdoors. Air vented out underneath a structure is nice and cool before mixing with the outdoor environment.

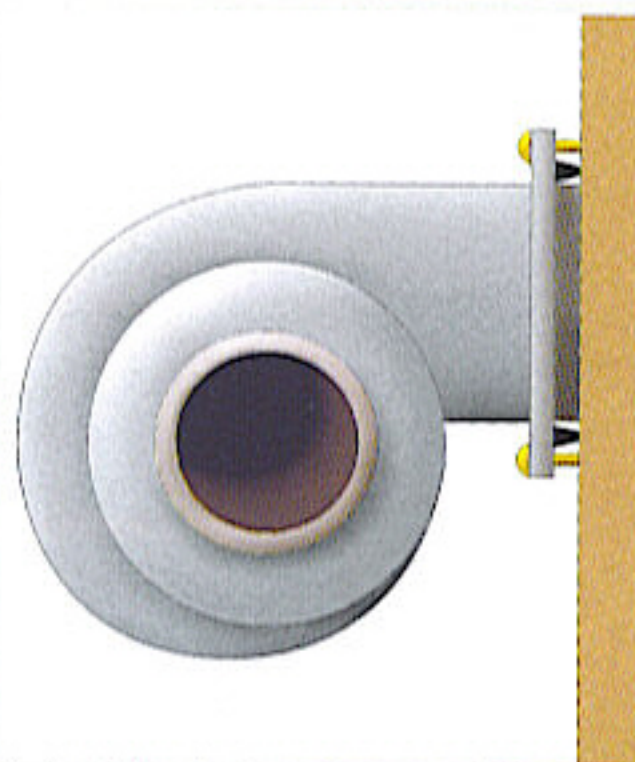
Growers having problems with thermal imaging should contact NORML, 1001 Connecticut Ave. NW, suite 710, Washington, DC 20036, Tel: 1-202-483-7205. They have an excellent study on thermal imaging devices and legal aspects compiled by Carlos Ghigiotti. This information could save another lawyer a lot of time.

In June of 2001, the Supreme Court decided a case brought against Oregon resident Danny Kyllo. The decision determined that the use of a thermal imaging device constitutes an illegal search. High-tech thermal imaging devices often get as much press as police bullying tactics. Law enforcement officials can legally lie, cheat, and steal to acquire evidence against peaceful, plant-loving growers. Deception is one of their biggest weapons, and snitches their best allies. Law enforcement legally coerces terrified growers into squealing on their friends and family. The lesson here is simple; do not tell anybody, under any circumstances, that you are growing in the United States of America. Growers are arrested daily on "hearsay" evidence from an arrested informant. Stay away from the heat.

One last bit of simple security detail: grow efficiently! Growers in a Drug War-torn America should harvest 0.5 grams of dried bud every month for each watt of light in the flowering room. Growers that do not harvest this much are cheating themselves and need to master the basics of growing. Always grow fewer than 99 total plants in America. Federal laws require a five-year minimum sentence with no parole when convicted of growing 100-1000 plants.



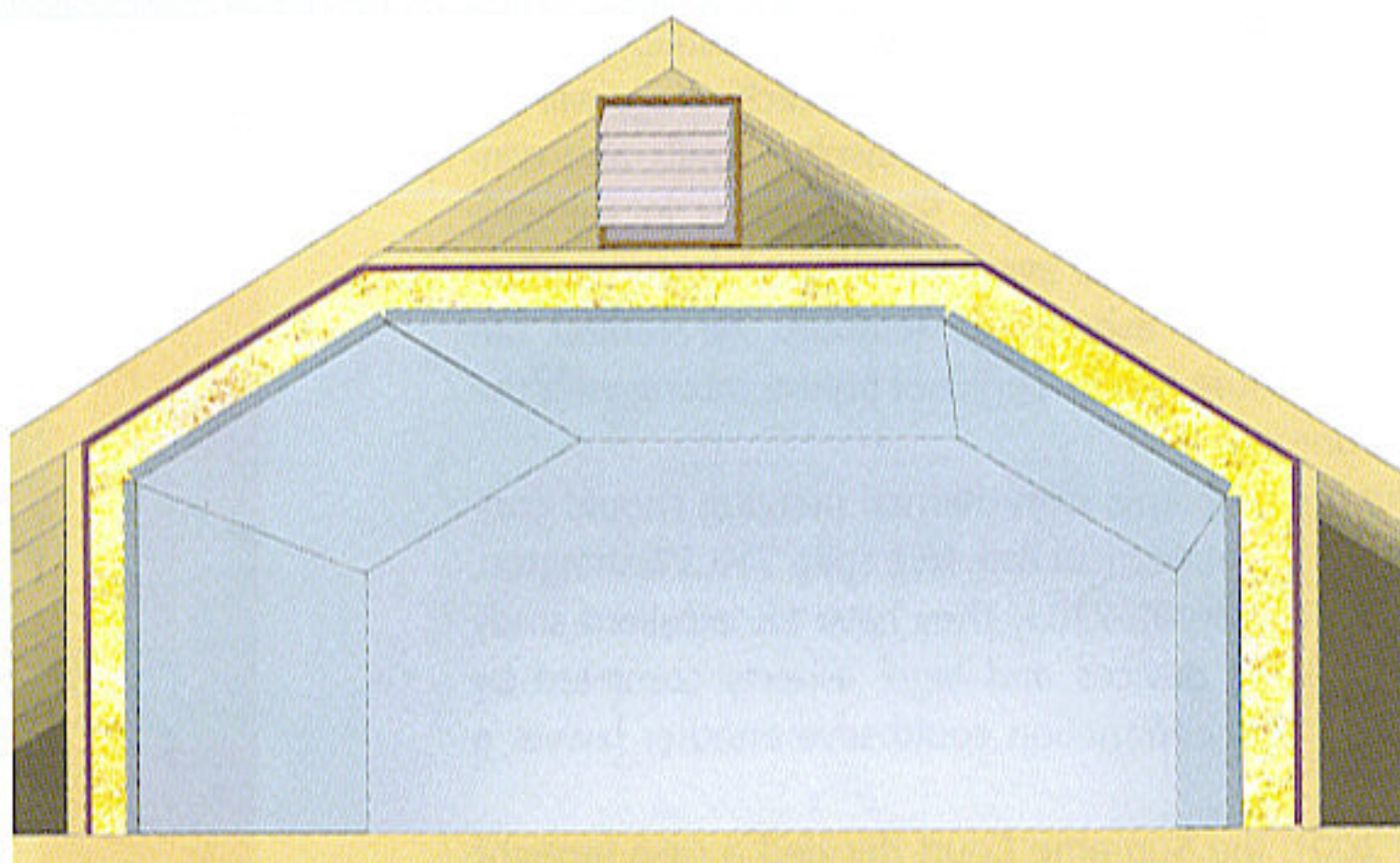
Always keep a fire extinguisher nearby.



Put rubber feet on fans and blowers to shunt vibrations and noise.



A carbon filter will remove the fragrance of cannabis before expelling grow room air.



Heavy insulation will keep grow room temperature easier to control and will help keep the heat signature inside.



This grow room has been lined with a material to keep the heat signature inside. For more information check www.hysupply.nl.

I would like to exchange e-mail with every reviewer that reviews my works. If you make a review on any of the websites that we have on our list, (please add those that are not listed below) I would like to give you a personal answer to your concerns about your review.

www.amazon.com

www.amazon.ca

www.amazon.co.uk

www.amazon.co.jp

www.amazon.de

www.amazon.fr

www.barnesandnoble.com

Our goal in making the Bible, is to give you the absolute best information in the world.

We are looking for ways to make this book the best possible! Do you have anything to add? If so, please hit our website, www.marijuanagrowing.com, for instructions.

If we use your information and you leave your name (alias is OK) you will receive credit in our next edition!

- Jorge Cervantes

CHAPTER ONE

MARIJUANA HORTICULTURE



With a little care you too can have a beautiful crop of 'Power Plant' indoors or outdoors!

Introduction

The key to successful indoor cannabis cultivation is to understand how cannabis produces food and grows. Cannabis, whether cultivated indoors or out, has the same requirements for growth. It needs light, air, water, nutrients, a growing medium, and heat to manufacture food and to grow. Without any one of these essentials, growth stops and death soon results. Indoors, the light must be of the proper spectrum and intensity; air must be warm, arid, and rich in carbon dioxide; water must be abundant but not excessive, and the growing medium must contain the proper levels of nutrients for vigorous growth. When all these needs are met consistently at optimum levels, optimum growth is the result.

Cannabis is normally grown as an annual plant, completing its life cycle within one year. A

seed that is planted in the spring will grow strong and tall through the summer and flower in the fall, producing more seeds. The annual cycle starts all over again when the new seeds sprout the following year. In nature, cannabis goes through distinct growth stages. The chart below delineates each stage of growth.

Life Cycle of Cannabis

After 3-7 days of germination, plants enter the seedling growth stage which lasts about a month. During the first growth stage the seed germinates or sprouts, establishes a root system, and grows a stem and a few leaves.

Germination

During germination moisture, heat, and air activate hormones (cytokinins, gibberellins, and auxins) within the durable outer coating of the seed. Cytokinins signal more cells to form and gib-



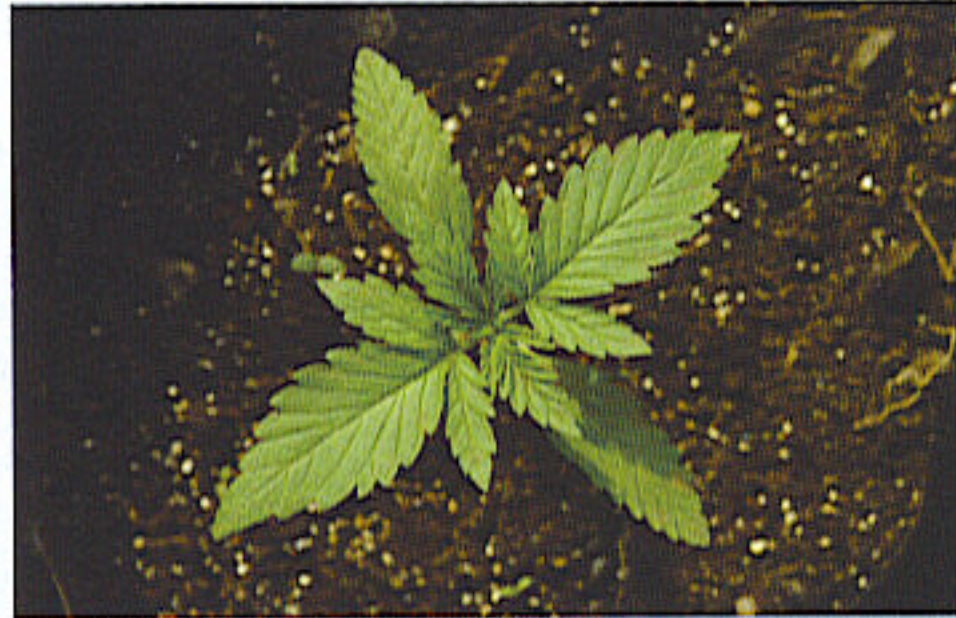
Strong healthy 'Chronic' seeds from Serious Seeds germinated after being soaked in water overnight.



Sprouted seed was placed between two pieces of a rock-wool seed block and caused virtually no transplant shock.



Strong healthy seedling emerges from a Jiffy™ cube. The sprouted seed was carefully inserted into a hole with the taproot pointing down.



Sweet Purple (Paradise) seedling shows perfect symmetrical growth. Leaflets will increase from three to as many as eleven during vegetative growth.

berellins to increase cell size. The embryo expands, nourished by a supply of stored food within the seed. Soon, the seed's coating splits, a rootlet grows downward, and a sprout with seed leaves pushes upwards in search of light.

Seedling Growth

The single root from the seed grows down and branches out, similar to the way the stem branches up and out above ground. Tiny rootlets draw in water and nutrients (chemical substances needed for life). Roots also serve to anchor a plant in the growing medium. Seedling should receive 16-18 hours of light to maintain strong healthy growth.

Vegetative Growth

Vegetative growth is maintained by giving plants 16-24 hours of light every day. As the plant matures, the roots take on specialized functions. The center and old, mature portions contain a water transport system and may also store food. The tips of the roots produce elongating cells that continue to push farther and farther into the soil in search of more water and food. The single-celled root hairs are the parts of the root that actually absorb water and nutri-



This 'Marley's Collie' (Sensi Seeds) is planted in a 5-gallon (19L) bucket and was grown in a greenhouse.



MIDDLE: Strong healthy roots are vibrant white. Feeder roots are fuzzy white. This rooted clone is ready to transplant.

LEFT: Male pre-flowers (a small nub above the fourth internode) develop on plants after about four weeks of vegetative growth.



This close-up shows female pre-flowers, white pistils growing from newly formed green calyx. Female pre-flowers usually sprout after male pre-flowers.



This large mother plant is growing in a 10-gallon (38 L) container. She can provide more than a hundred clones every month.

ents. Without water, frail root hairs will dry up and die. They are very delicate and are easily damaged by light, air, and klutzy hands if moved or exposed. Extreme care must be exercised during transplanting.

Like the roots, the stem grows through elongation, also producing new buds along the stem. The central or terminal bud carries growth upward; side or lateral buds turn into branches or leaves. The stem functions by transmitting water and nutrients from the delicate root hairs to the growing buds, leaves, and flowers. Sugars and starches manufactured in the leaves are distributed through the plant via the stem. This fluid flow takes place near the surface of the stem. If the stem is bound too tightly by string or other tie downs, it will cut the flow of life-giving fluids, thereby strangling and killing the plant. The stem also supports the plant with stiff cellulose, located within the inner walls. Outdoors, rain and wind push a plant around, causing much stiff cellulose production to keep the plant supported upright. Indoors, with no natural wind or rain present, stiff cellulose production is minimal, so plants develop weak stems and may need to be staked up, especially during flowering.

Once the leaves expand, they start to manufacture food (carbohydrates). Chlorophyll (the substance that gives plants their green color) converts carbon dioxide (CO_2) from the air, water, and light energy into carbohydrates and oxygen. This process is called photosynthesis. It requires water drawn up from the roots, through the stem, into the leaves where it encounters carbon dioxide. Tiny breathing pores called stomata are located on the underside of the leaf and funnel CO_2 into contact with the water. In order for photosynthesis to occur, the leaf's interior tissue must be kept moist. The stomata open and close to regulate the flow of moisture, preventing dehydration. Marijuana leaves are also protected from drying out by an outer skin. The stomata also permit the outflow of water vapor and waste oxygen. The stomata are very important to the plant's well being and must be kept

clean to promote vigorous growth. Dirty, clogged stomata would breathe about as well as you would with a sack over your head!

Pre-Flowering

Cannabis grown from seed dawns pre-flowers after the fourth week of vegetative growth. They generally appear between the fourth and sixth node from the bottom of the plant. Cannabis plants are normally either all male or all female. Each sex has its own distinct flowers. Pre-flowers will be either male or female. Growers remove and destroy the males (or use them for breeding stock) because they have low levels of cannabinoids (THC, CBD, CBN, etc.). Female plants are cultivated for their high cannabinoid content.

Mother Plants

Growers select strong, healthy, potent mother plants they know are female. Mothers are given 18-24 hours of light daily so they stay in the vegetative growth stage. Growers cut branch tips from the mother plants and root them. The rooted cuttings are called "clones." Cultivating several strong, healthy mother plants is the key to having a consistent supply of all-female clones.

Cloning

Branch tips are cut and rooted to form clones. Clones take 10-20 days to grow a strong healthy



Once the branch tip has been cut, bottom leaves are trimmed off before planting the clone, an exact replica of the mother plant.



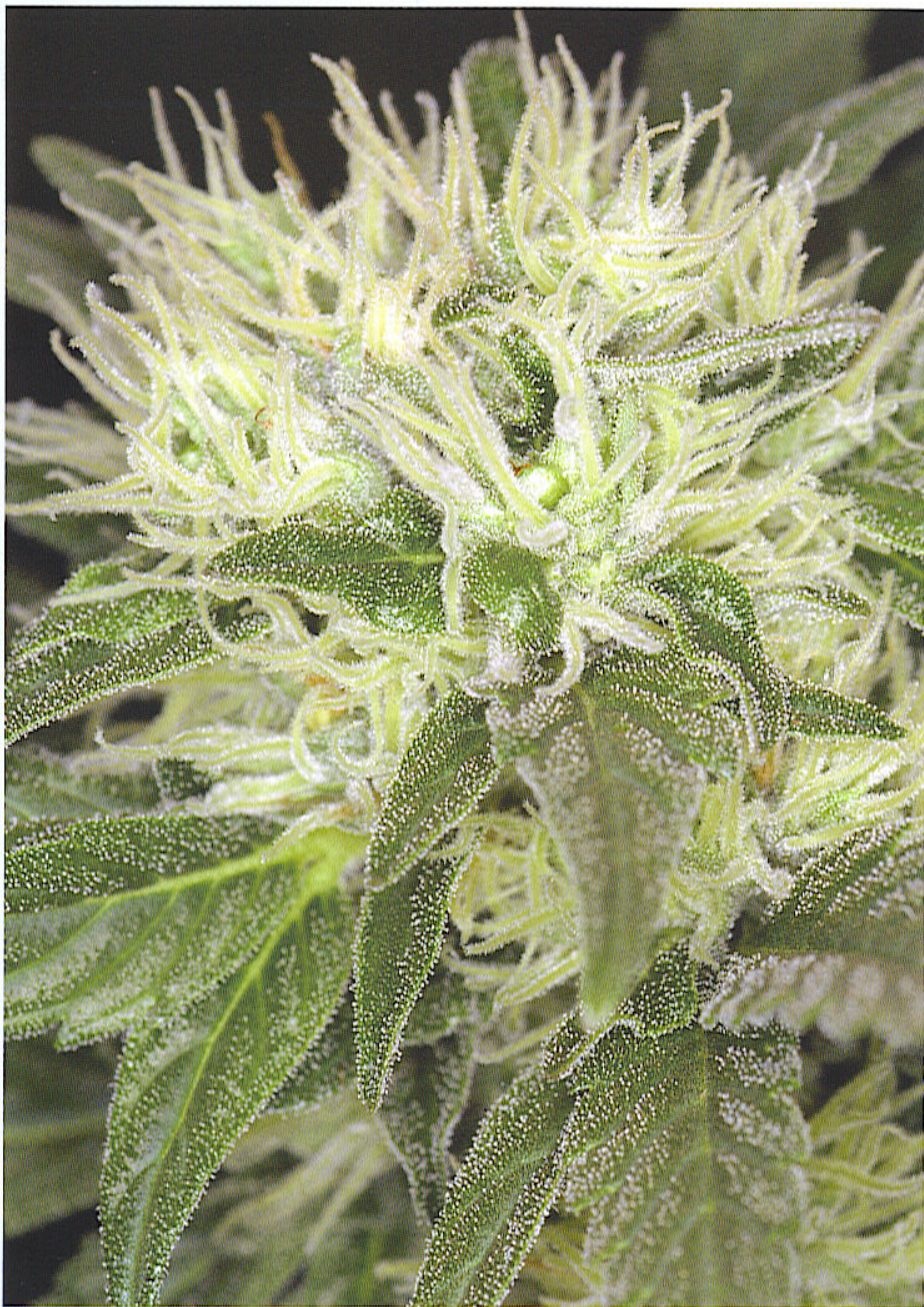
Clones grow a strong root system in 14-21 days under fluorescent light. Once rooted, they spend from 7-30 days in vegetative growth.



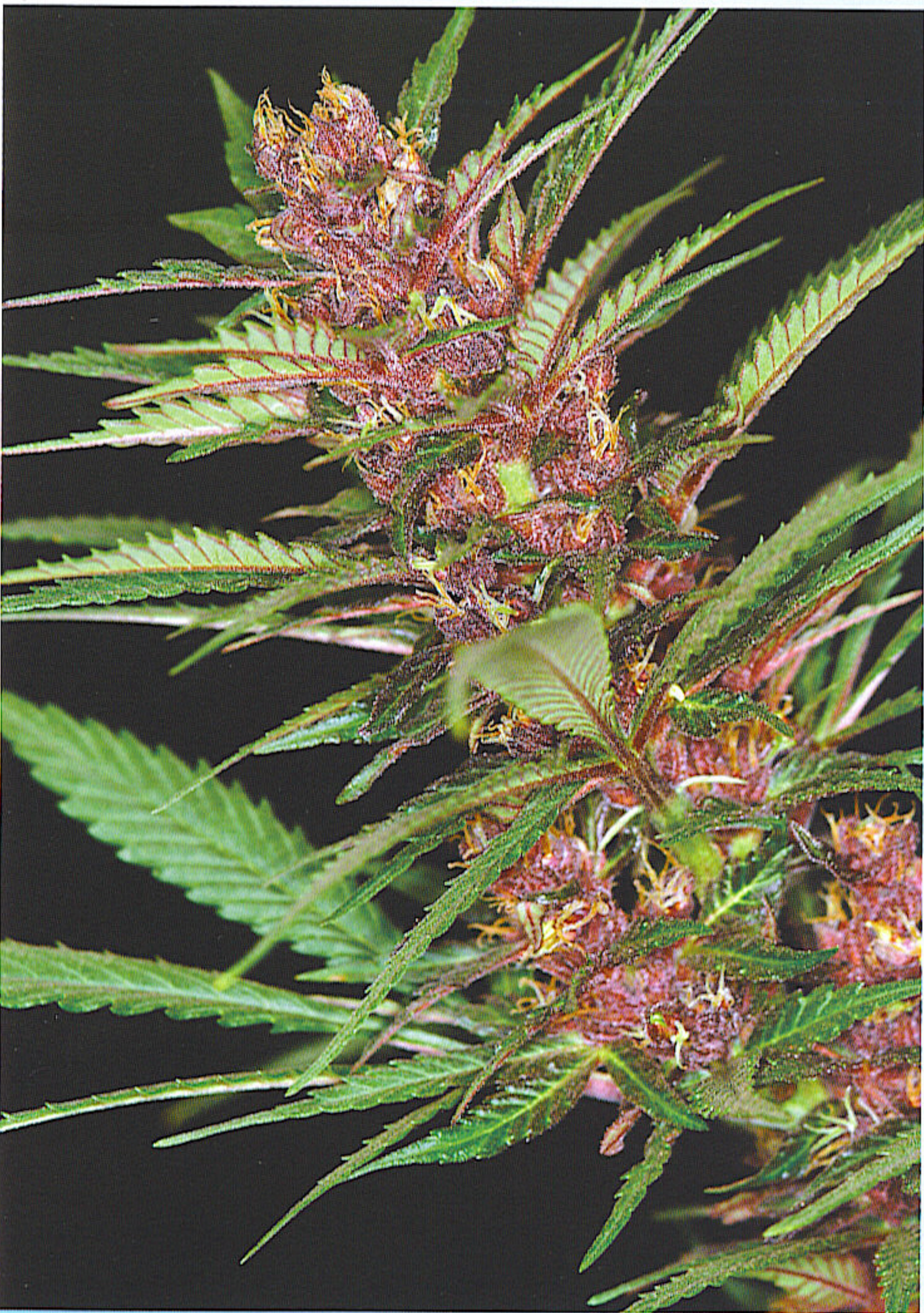
'Haze Heaven' female is starting to flower heavily. Branch internodes are shorter and white female pistils grow from calyxes.



Male plants flower before females. Males show signs of flowering after receiving a week or more of 12/12 day/night photoperiod.



Many receptive female pistils on this 'Hash Plant' await pollination from male pollen. Left unfertilized, female plants continue to produce more and more cannabinoids.



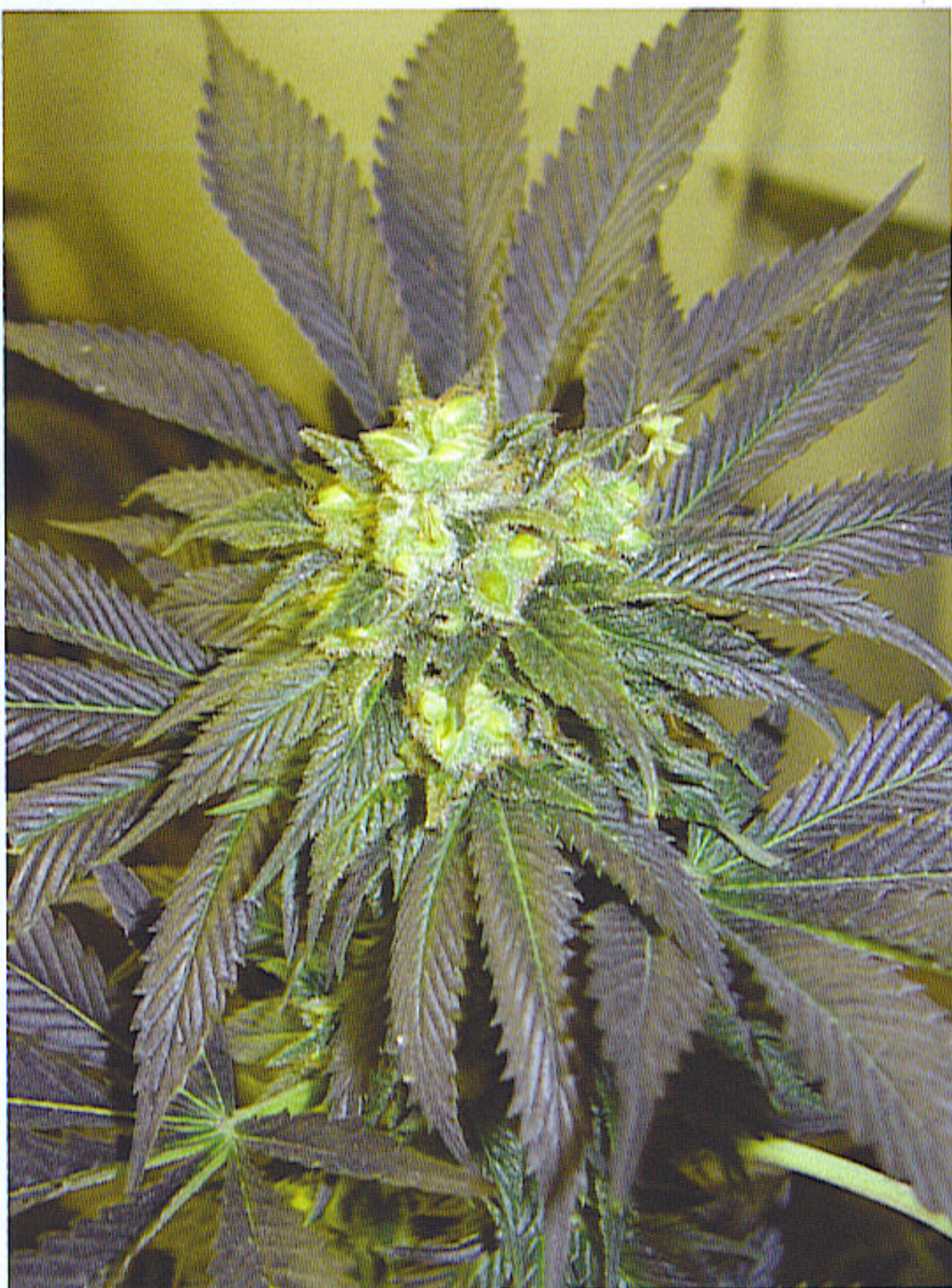
'Purple #1'

root system. Clones are given 18-24 hours of light so they stay in the vegetative growth stage. Once the root system is established, clones are transplanted into larger containers. Now they are ready to grow for 1-4 weeks in the vegetative growth stage before being induced to flower.

Flowering

Cannabis flowers outdoors in the fall when days become shorter and plants are signaled that the annual life cycle is coming to an end. At flowering, plant functions change. Leafy growth slows, and flowers start to form. Flowering is triggered in most commercial varieties of cannabis by 12 hours of darkness and 12 hours of light every 24 hours. Plants that developed in tropical regions often start flowering under more light and less darkness. Flowers form during the last stage of growth. Left unpollinated, female flowers develop without seeds, "sinsemilla." When fertilized with male pollen, female flower buds develop seeds.

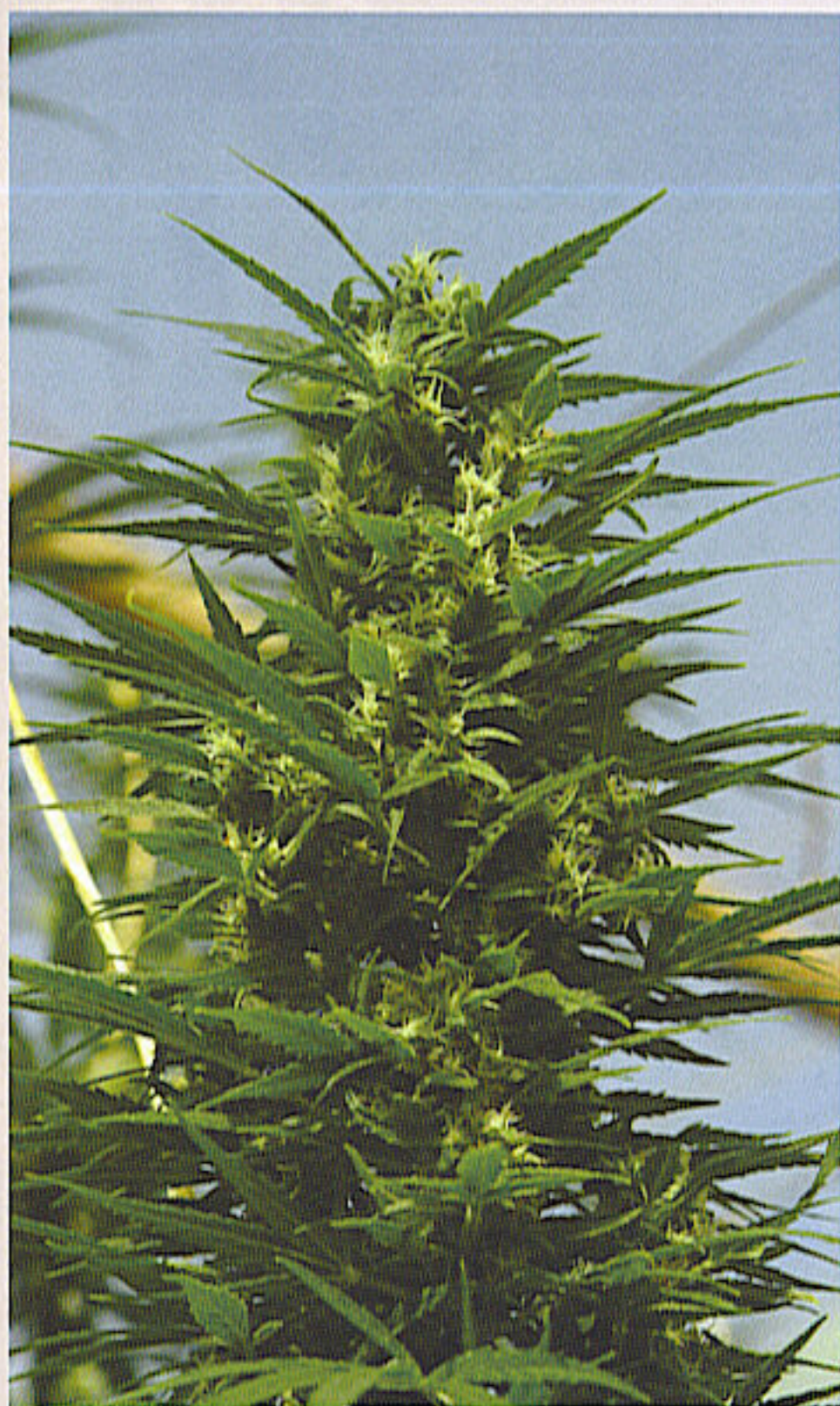
Unpollinated, female cannabis flowers continue to swell and produce more resin while waiting for male pollen to successfully complete their life cycle. After weeks of heavy flower and cannabinoid-laden resin production, THC production peaks out in the unfertilized, frustrated sinsemilla!



This pollinated female is packed with seeds. Once fertilized with male pollen, females put the bulk of their energy into producing strong, healthy seeds.

Cannabis has both male and female plants. When both male and female flowers are in bloom, pollen from the male flower lands on the female flower, thereby fertilizing it. The male dies after producing and shedding all his pollen. Seeds form and grow within the female flowers. As the seeds are maturing, the female plant slowly dies. The mature seeds then fall to the ground and germinate naturally or are collected for planting next spring.





The main bud on this 'Thai' plant growing under the tropical sun appears to be much denser than it actually is.



Leaf from the strain 'Thaitanic' demonstrates the classic *C. sativa* characteristics—long, thin blades or fingers.

Cannabis Strains

Technically and legally, all cannabis, whether rope or dope, is classified as *Cannabis sativa*. Regardless of origin, all cannabis is considered *Cannabis sativa* (*C. sativa*) under international law. However, according to *Hemp Diseases and Pests*, Dr. J. M. McPartland, R. C. Clarke, and D. P. Watson, CAB International, *Cannabis sativa* can be further classified as: *Cannabis sativa* (= *C. sativa* var. *sativa*), *Cannabis indica* (= *C. sativa* var. *indica*), *Cannabis ruderalis* (= *C. sativa* var. *spondanea*), *Cannabis afghanica* (= *C. sativa* var. *afghanica*). Each has distinct growth patterns, look, smell, taste, etc.

Cannabis Sativa

Cannabis sativa (= *C. sativa* var. *sativa*), originated predominately in Asia, the Americas, and Africa. Each area of origin has specific characteristics, but all have the following general traits: tall, leggy stature with spacious internodal length, a large sprawling root system, large narrow-bladed leaves, and somewhat sparse flowers when grown indoors under lights. *Sativas* bloom several weeks to months later than *indica* strains. While good producers outdoors, often growing to 15 feet (4.5 m) or more, indoors pure *sativa* strains often grow too tall too fast—some up to ten feet in three months—to be practical for grow room cultivation. An HID bulb is unable to efficiently illuminate tall plants, and the yield-per-watt-of-light or yield-per-square-foot-of-space is very low. Mexican, Columbian, Thai, and Jamaican strains can be very potent, with a high THC to CBD ratio that produces a soaring, energetic, "speedy" high. But potency can also be minimal, with low levels of THC. Most exported Columbian, Mexican, Thai, and Jamaican marijuana is poorly treated throughout life and abused when dried and packed. This abuse causes more rapid

degradation of THC. Consequently, seeds from fair smoke are often more potent than the parent.

Central African *sativas*, including the THC-potent 'Congolese', grow similarly to Columbian strains, with a tall leggy stature, often growing more than 15 feet (4.5 meters) tall with loosely packed buds.

South Africa has major seaports. Sailors brought *Cannabis sativa* from many different places and planted it in South Africa. Consequently, potency of South African weed can be very high or very low, and can grow short, tall, leggy, bushy, etc. The famous 'Durban Poison' yields potent, pale-green, early buds and is the best-known South African strain.

Asian *sativas*, including Thai, Vietnamese, Laotian, Cambodian, and Nepalese, have diverse growth characteristics and vary significantly in potency. While Thai and other *sativas* from the area are often super THC-potent, they are some of the most difficult to grow indoors and the slowest to mature. Thai strains produce very light, wispy buds after flowering for about four months on plants with large, sprawling branches. Thai, Vietnamese, Cambodian, and Laotian *sativas* are more prone to grow into hermaphroditic adults.

Nepalese *sativas* can grow oversized leaves on tall leggy plants that produce sparse, late-blooming buds, but other strains from this region develop into short, compact plants that bloom earlier. Tetrahydrocannabinol (THC) production and potency is often quite high, but can also be second-rate.

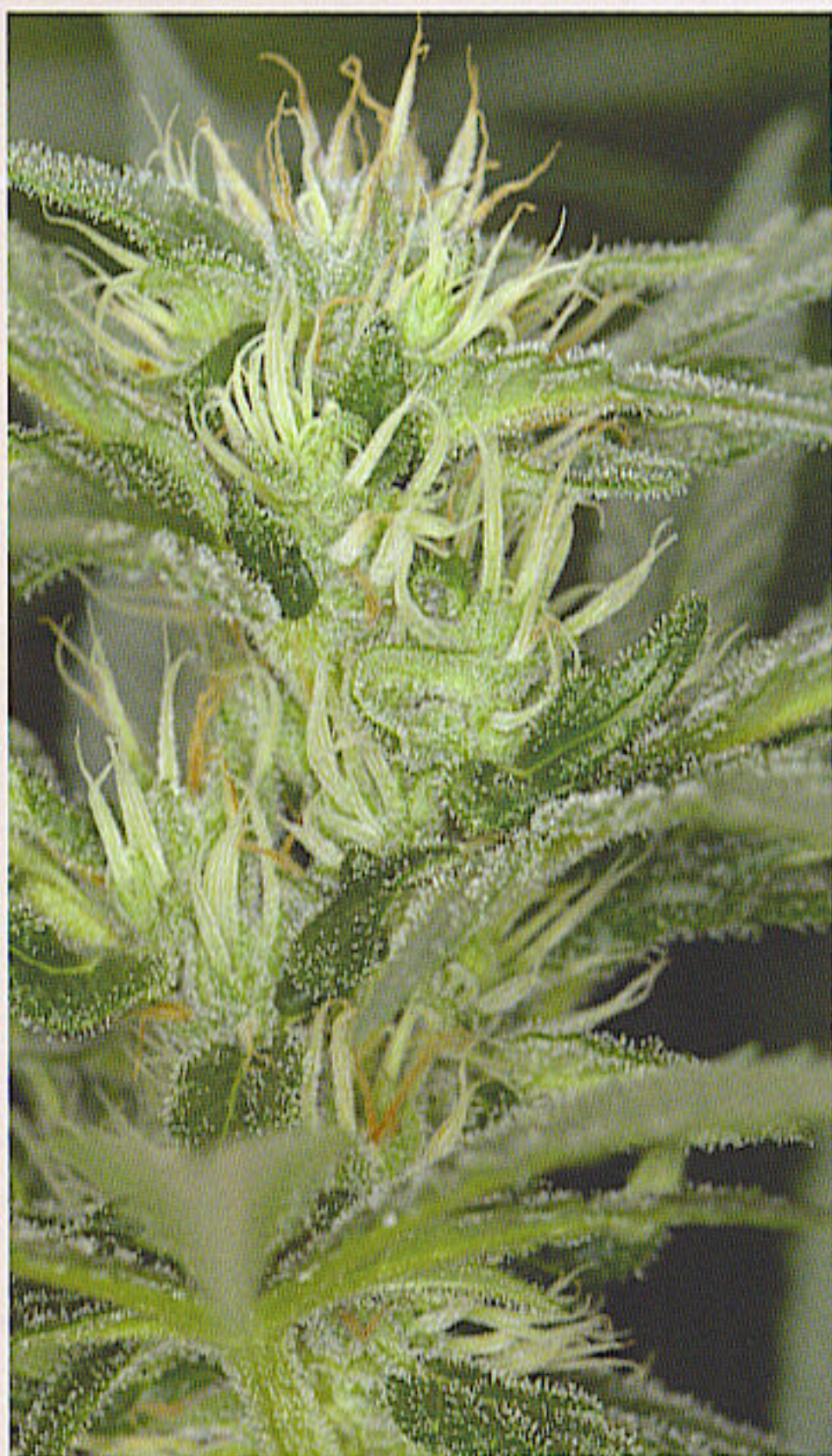
Hemp strains are all considered to be *Cannabis sativa*. Hemp, affectionately referred to as "rope," is *Cannabis sativa* grown for fiber content. Hemp is often seeded and contains very, very low levels of THC.



This leaf from an industrial hemp plant came from the French entity Chanvre & Co. Industrial "no high" cannabis will pollinate drug cannabis.

Cannabis Indica

Cannabis indica (= *C. sativa* var. *indica*) originated in Pakistan and India. *Indica* is prized by indoor growers and breeders for its squat, bushy growth; condensed root system; stout stems; broad leaves; and dense, THC-laden, fat heavy flowers. Foliage is very dark green, and in some strains, leaves around buds turn reddish to purple. Short, whitish pistils turn reddish to purplish in hue. A few *indicas* from this part of the world have narrower leaves, long white pistils, and pale green foliage. *Indica* strains generally contain a higher ratio of CBD to THC, which causes an effect often described as a heavy, incapacitating "sit-on-your-head" stone. Potency of the "high" ranges from fair to stupefying. Some *indicas* have a distinctive odor similar to that of a skunk or cat urine, while others smell sweet and exotic. Heavily resin-laden plants tend to be the most fungus and pest-resistant. Few *indicas* with heavy, dense, compact buds are resistant to gray (bud) mold.



Cannabis indica plant.



Cannabis indica leaf has broader blades than C. sativa leaves, but not as broad as C. afghanica.

Cannabis Ruderalis

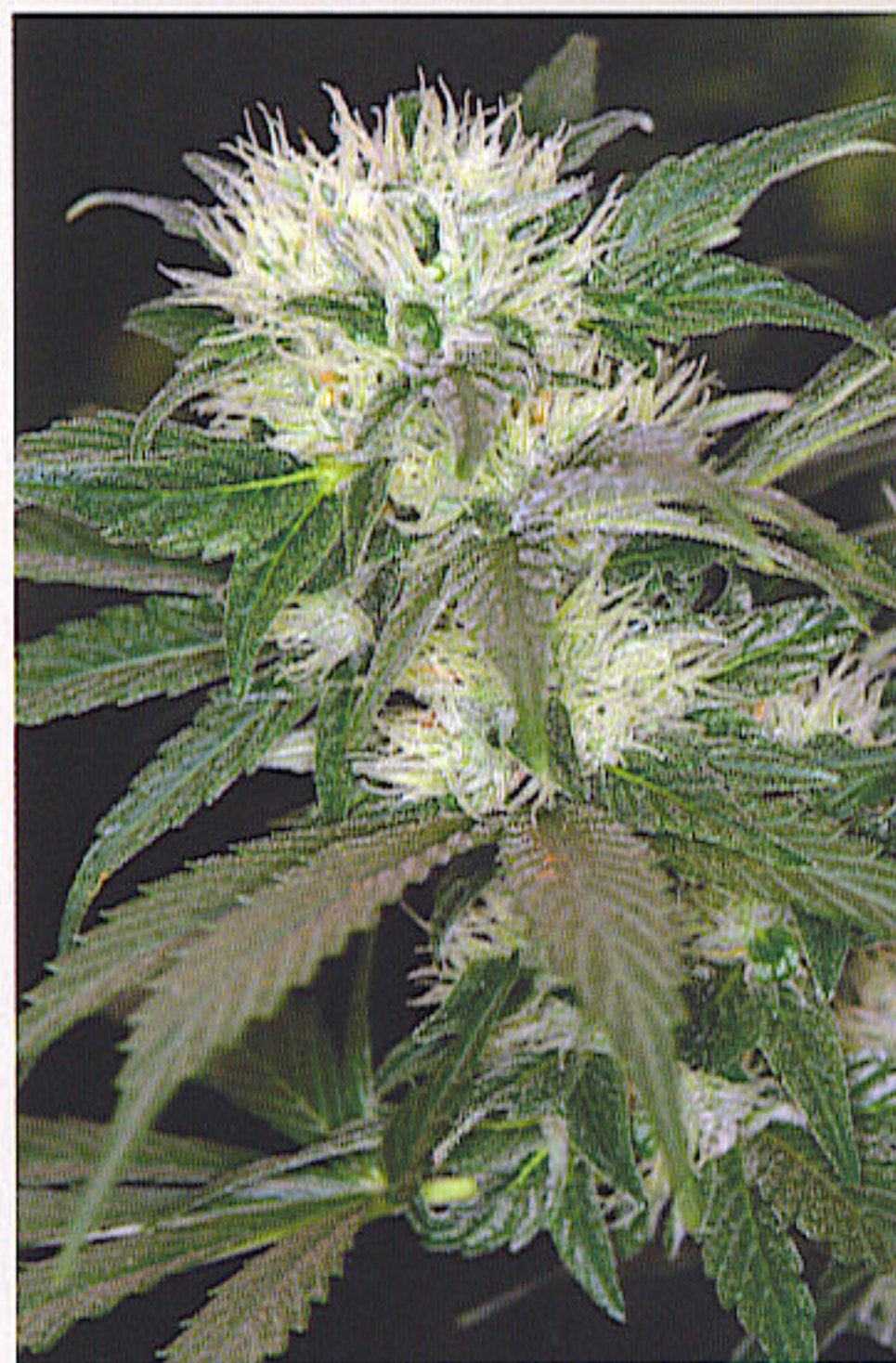
Cannabis ruderalis (= *C. sativa* var. *spondanea*) was first brought to Amsterdam from Central Europe in the early 1980s by the Seed Bank to enhance their breeding program. Very similar, if not the same "*ruderalis*" plants grow from Minnesota north through Manitoba and Saskatchewan, Canada. *C. ruderalis* is a short, weedy, scrubby plant containing very, very little THC, but it starts the flowering cycle after a few weeks growth. Photoperiod does not induce flowering in *C. ruderalis*. Sometimes confused with more potent indicas, pure *C. ruderalis* is true ditch weed. It yields a headache rather than a high! Today a few breeders have incorporated the early flowering *C. ruderalis* genes with other early blooming *C. sativa*, *C. indica*, and *C. afghanica*.



'Lowryder' is one of the few C. ruderalis crosses that is auto-flowering and THC-potent.

Cannabis Afghanica

Cannabis afghanica (= *C. sativa* var. *afghanica*) originated near present day Afghanistan. It is quite short, seldom reaching six feet, with distinctive, broad, dark-green leaflets and leaves. Dense branching and short internodes, most often with long leaf stems (petioles), dominate the profile of *C. afghanica*. The most common examples of pure *C. afghanica* include the many different hash plants and Afghani strains. *C. afghanica* is cultivated exclusively for drugs with much of the resin being made into hashish. It is known for the high cannabinoid content. Many growers and breeders do not distinguish *C. afghanica* from *C. indica*, lumping them both into the *C. indica* category.



'Hash Plant', of which there are many, is one of the classic *C. afghanica* strains.



THE SEED BANK 1987 Revised Catalogue

One of the first Seed Bank catalogs from 1987 shows a *C. ruderalis* plant alongside the highway in Hungary. Many breeders mistakenly hailed this plant as the "Holy Grail" of cannabis.



C. afghanica has very wide and distinctive leaflets and leaves.



Close-up of 'Power Plant' seeds..



Close-up of 'Eclipse' seeds.



'Kali Mist' seeds are spotted and mottled.

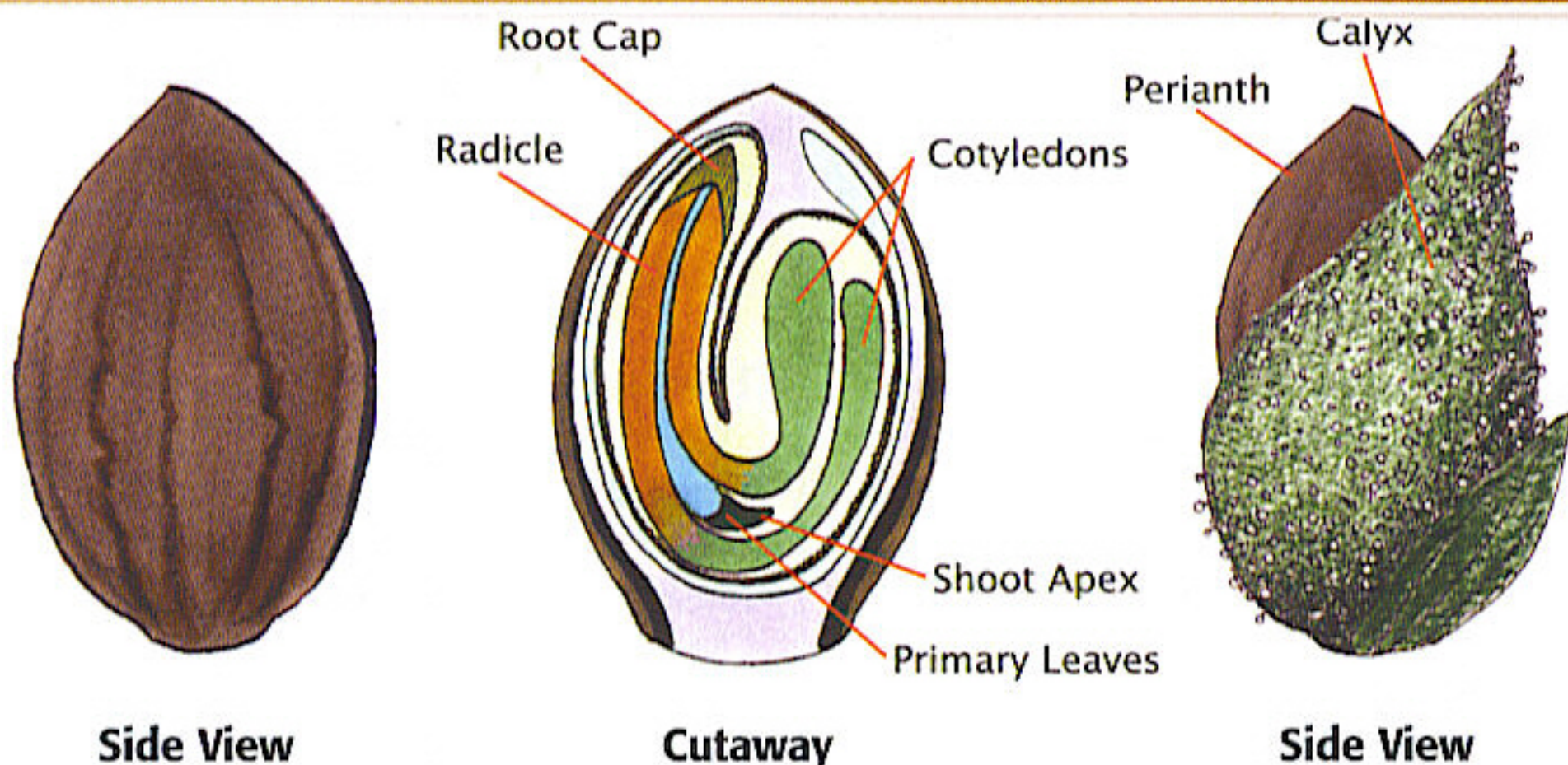
Seeds

Explosive growth of seed breeders and legal seed sales in the Netherlands, the United Kingdom, Canada, France, Switzerland, Spain, etc., has given way to more strains of cannabis than ever before. Most popular strains of cannabis are a combination of two or more of the following: *C. sativa*, *C. indica*, *C. ruderalis*, and *C. afghanica*. But there are also many seeds with the genes from just one of the above. These strains of cannabis are bred to grow best indoors. Others grow best in greenhouses, and still others outdoors in specific climates. See Chapter Seventeen, "Breeding," for information about hybrid seeds including F1, F2, F3, etc., hybrids.

A seed contains all the genetic characteristics of a plant. Seeds are the result of sexual propagation and contain genes from each parent, male and female. Some plants, known as hermaphrodites, bear both male and female flowers on the same plant. The genes within a seed dictate a plant's size; disease and pest resistance; root, stem, leaf, and flower production; cannabinoid levels; and many other traits. The genetic makeup of a seed is the single most important factor dictating how well a plant will grow under artificial light or natural sunlight and the levels of cannabinoids it will produce.

Strong, healthy parents and proper care yield strong seeds that germinate well. Strong seeds produce healthy plants and heavy harvests. Seeds stored too long will germinate slowly and have a high rate of failure. Vigorous seeds initiate growth within seven days or sooner. Seeds that take longer than a month to germinate could always be slow and produce less. However, some seeds take longer to germinate even under the best conditions.

The cask, or outer protective shell, on some seeds never properly seals, which allows moisture and air to penetrate. It also causes



The cutaway drawing in the center shows how the seed will develop into different plant parts.

hormone concentrations to dissipate and make seeds less viable. Permeable seeds signal diseases and pests to move in. Such seeds are immature, white, fragile, and crush easily with slight pressure between finger and thumb. These are weak seeds and do not have enough strength to grow well.

Typically, a grower who acquires a bag of ten quality seeds from a reputable seed company germinates them all at once. Once germinated, the seeds are carefully planted and grown to adulthood. By and large, of the ten seeds, some will be male, some will be weak and grow poorly, and two or three seeds will grow into strong, super females. Of these "super" females, one will be more robust and potent than her siblings. This super female is selected to be the mother of countless super clones.

A simple picture of a seed reveals an embryo containing the genes and a supply of food wrapped in a protective outer coating. Mature seeds that are hard, beige to dark brown, and spotted or mottled have the highest germination rate. Soft, pale, or green seeds are usually immature and should be avoided. Immature seeds germinate poorly and often produce sickly plants. Fresh, dry, mature seeds less than a year old sprout quickly and grow robust plants.

Germination

Cannabis seeds need only water, heat, and air to germinate. They do not need extra hormones to germinate. Seeds sprout without light in a wide range of temperatures. Properly nurtured seeds germinate in two to seven days, in temperatures from 70-90°F (21-32°C). Temperatures above 90°F (32°C)



Seeds in this seeded female swell and break open the seed bract.

Timeline for germinating seeds

At 55-72 hours

Water is absorbed
Root tip (radicle) is visible

At 10-14 days

First roots become visible

At 21-30 days

At least half of seeds are rooted by day 21.
Seeds not rooted by day 30 will probably grow slowly

Once seeds are rooted, cell growth accelerates; stem, foliage, and roots develop quickly. Seedlings develop into full vegetative growth within four to six weeks of germination.

impair germination. At germination, the outside protective shell of the seed splits, and a tiny, white sprout (radicle) pops out. This sprout is the root or taproot. Cotyledon, or seed leaves, emerge from within the shell as they push upward in search of light.

Seeds are prompted to germinate by:

Water
Temperature
Air (oxygen)

Water

Soaking seeds in water allows moisture to penetrate the protective seed shell within minutes. Once inside, moisture continues to wick in to activate the dormant hormones. In a few days, hormones activate and send enough hormone signals to produce a radicle. The radicle emerges upward to bring a new plant into the world. Once a seed receives moisture, there must be a constant

stream of moisture to transport nutrients, hormones, and water in order to carry on life processes. Letting germinated seeds suffer moisture stress now will stunt seedling growth.

Temperature

Cannabis seeds grow best at 78°F (25°C).

Low temperatures delay germination.

High temperatures upset seed chemistry causing poor germination.

Seeds germinate best under the native conditions where they were grown.

Once germinated, move seedlings to a slightly cooler growing area, and increase light levels. Avoid high temperatures and low light levels, which cause lanky growth.

Air (oxygen)

Seeds need air to germinate. Moist, soggy growing mediums will cut off oxygen supplies and the seed will literally drown. Planting seeds too deeply also causes poor germination. Seedlings do not have enough stored energy to force through too much soil before sprouting. Plant seeds twice as deep as the width of the seed. For example, plant a 0.125-inch (0.3 mm) seed 0.25-inch (6 mm) deep.

Household water contains enough dissolved solids (food) to nourish seeds through their first few weeks of life. Although seeds need only 30-50 ppm of nitrates before they germinate, any more will disrupt internal chemistry. Some growers prefer to use distilled water that contains virtually no dissolved solids to germinate seeds. In fact, a high concentration of dissolved solids (salts) in the water will actually pull moisture out of the seed!

Start feeding two to four weeks after seedlings have sprouted. Some growers wait until leaves yellow to begin feeding. Use a mild quarter-strength solution. If yellowing persists, give seedlings a little more fertilizer.

Some seeds have a very hard outer shell, testa, and must be scarified to allow water to penetrate. To scarify, line a matchbox with a piece of fine-grain sandpaper or emery board. Put the seeds in the matchbox and shake for about 30 seconds. Remove the seeds, and make sure they have been scuffed a bit. Just a little scuffing will allow water to enter and set germination in motion.

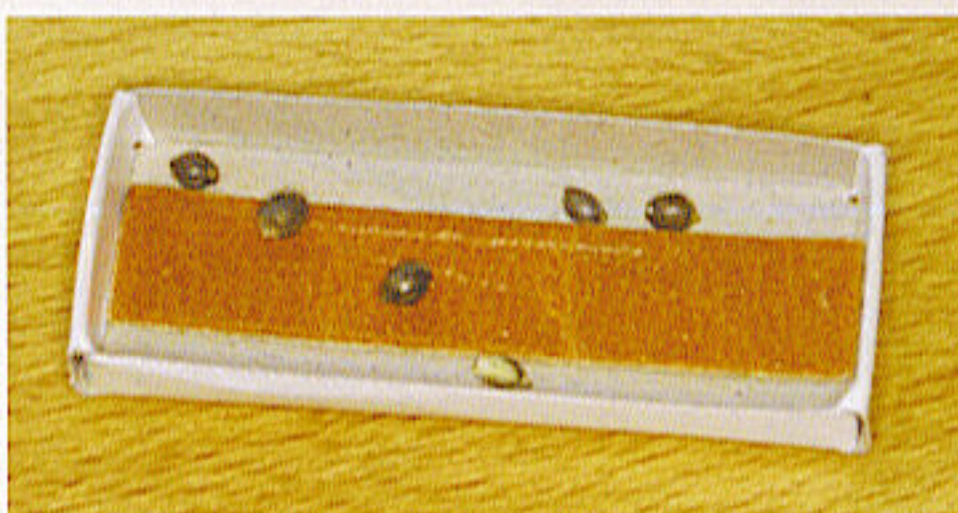
Two Popular Germination Techniques:

One: Pre-soaking in water

Soak seeds overnight in a glass of water. Make sure seeds get good and wet so growth is activated. Do not let seeds soak more than 24 hours, or they might get too wet, suffer oxygen deprivation, and rot. Once soaked, seeds are ready to be placed between moist paper towels to sprout or be planted in a root cube or fine, light soilless mix.

In a warm location (70-90°F, [21-32°C]), place seeds in a moist paper towel or cheesecloth, making sure they are in darkness. Set the moist cloth or paper towel in a vertical position (so tap root grows down) on a grate (for drainage) on a dinner plate.

Water the cloth daily, and keep it moist. Let excess water drain away freely. The cloth will retain enough moisture to germinate the seed in a few days. The seed contains an adequate food supply for germination. Prevent fungal attacks by watering with a mild two-percent bleach or fungicide solution. Once seeds have sprouted and the white sprout is visible, carefully pick up the fragile sprouts (with tweezers) and plant them. Take care not to expose the tender rootlet to prolonged intense light or air. Cover the germinated seed with 0.25-0.5-inch (1-2 cm) of fine planting medium with the white root tip pointing down.



To scarify seeds, place a small emery board inside a matchbox along with seeds.



Close the match box with the seeds and emery board inside.



Shake the box for about 30 seconds to rough up and scuff the seeds, so water can penetrate the outer shell.



Soak seeds in water overnight to germinate before planting.



Place seeds between leaves of a paper towel on a plate to germinate.



Add water to moisten the paper towel. Tip plate to drain off excess moisture.



Jiffy pellets expand when water is added. They make excellent pop-up pots to grow seedlings. They are also very easy to transplant.

Two: Direct seed

One of the problems with rockwool can be that the seeds heave out before germinating. This is why it is best to germinate seeds before putting them into the rockwool substrate.

Once seeds have sprouted and the white sprout is visible, carefully pick up the fragile sprouts (with tweezers) and plant them in a pre-drilled hole in the rockwool with the white root tip pointing down. Take care not to expose the tender rootlet to prolonged intense light or air. Cover the germinated seed with one-quarter to one-half inch of moist rockwool. Keep the rockwool evenly moist. Once the taproot sprouts, small fuzzy feeder roots will grow in 12-14 days.

Water penetrates the outer protective shell, continues to wick in, and activates dormant hormones that induce germination. Once a seed receives moisture, there must be a constant stream of moisture to transport nutrients, hormones, and water to carry on life processes. Letting germinated seed suffer moisture stress now will stunt or stop seedling growth. The black tip of the root tells me this is what has happened.

Soggy growing mediums cut oxygen supplies and cause seeds to drown. Planting seeds too deeply causes poor germination.



Seeds set inside rockwool blocks often heave up and out. Germinate seeds before planting to avoid this common problem.

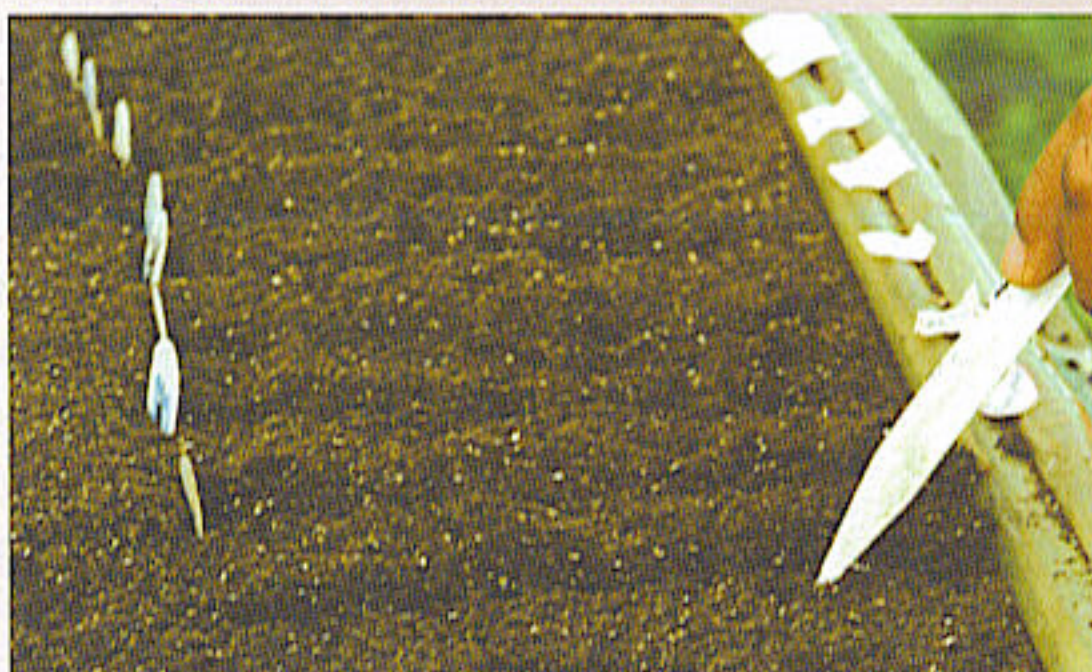
Seedlings do not have enough stored energy to force through too much soil before sprouting. Plant seeds twice as deep as the width of the seed. For example, plant an eighth-inch seed one-quarter inch deep.

Seeds do not need any extra hormones to germinate. Household water contains enough dissolved solids, food, to nourish seeds through their first few weeks of life. Supplemental nutrients will disrupt internal chemistry. Some growers prefer to use distilled water which contains virtually no dissolved solids to germinate seeds.

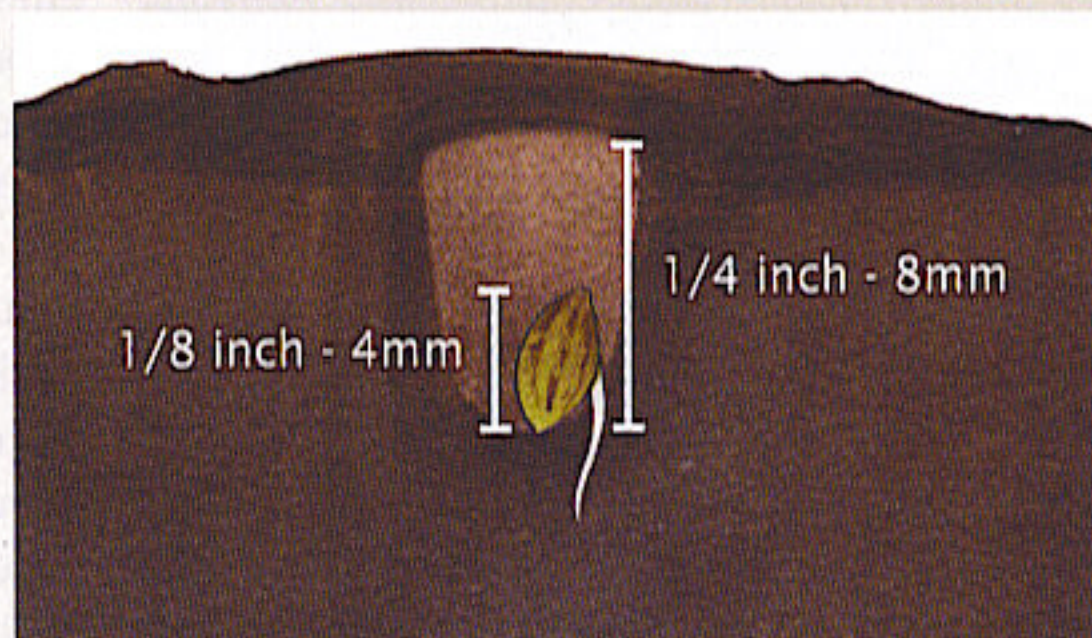
Sow (direct seed) or move the sprout into a shallow planter, small seed pot, peat pellet, or rooting cube. Keep the planting medium evenly moist. Use a spoon to contain the root ball when transplanting from a shallow planter. Peat pellets or root cubes may be transplanted in two to three weeks or when the roots show through the sides. Feed with a dilute, quarter-strength fertilizer solution.

Construct a moisture tent over the seedling container to help retain even grow-medium moisture. To build, place a baggie or piece of cellophane over the seeded soil. The cover will keep the humidity and temperature elevated. Seeds usually need only one initial watering when under a humidity tent. Remove the cover as soon as the first sprout appears aboveground. Leaving the tent on after seeds sprout through soil will lead to damping-off and other problems.

Place planted seeds under an HID lamp to add dry heat while germinating. The heat dries soil, which requires more frequent watering. Place a heat pad or soil heating cables below growing medium to expedite germination. Marijuana seeds germinate and sprout quickest when the soil temperature is between 78-80°F (24-27.5°C) and the air temperature is 72-74°F (22-23°C). But stems



This outdoor grower made a seedbed from fine potting soil. He has started hundreds of seeds in this seedbed.



Plant seeds twice as deep as the seed is wide.

will stretch between internodes if temperatures exceed 85°F (29°C) for long.

Over-watering and under-watering are the biggest obstacles most growers face when germinating seeds and growing seedlings. Keep the soil uniformly moist, not waterlogged. Do not let the growing medium surface dry for long. Keep it evenly moist. Setting root cubes or planting flats up on a grate allows good drainage. A shallow flat or planter with a heat pad underneath may require daily watering, while a deep, one-gallon pot will need watering every three days or more. A properly watered flat of rock-wool cubes needs water every three to five days when sprouting seeds. When the surface is dry (0.25-inch [7 mm] deep) it is time to water. Remember, there are few roots to absorb the water early in life, and they are very delicate.



This germinated seedling was allowed to dry out for a little more than an hour. Notice how the tip of the root has shriveled. This seemingly small oversight caused the resulting plant to have a very slow start in life.

Grow More Female Plants from Seed

Environmental factors start influencing sex the moment the seedling has three pairs of true leaves (not counting cotyledons). Environmental factors that influence sex determination of cannabis include but are not limited to:

Increasing the level of nitrogen makes more female plants. Lower the nitrogen level to create more male plants. Increase the level of potassium to increase male tendencies; lowering the potassium level encourages female plants. A higher nitrogen level and a lower potassium level for the first two weeks increases females.

Low temperatures increase the number of female plants. Warm temperatures make more male plants.

High humidity increases the number of female plants. Low humidity increases male plants.

Low growing-medium moisture increases males.

More blue light increases the number of female plants. More red light increases male tendencies.

Fewer hours of daylight (e.g. 14 hours) increases the number of females. Longer

days (e.g. 18 hours) make more male plants.

Stress: any environmental stress tends to yield more male plants when growing from seed.

Henk, owner of Dutch Passion Seeds, <http://www.dutch-passion.nl>, was kind enough to allow us to adapt this information from his archives.

See Chapter Seventeen, "Breeding," for information on producing feminized seeds.

Seedlings

When a seed sprouts, the white taproot emerges. Soon afterward, the cotyledon, also known as seed or seedling leaf, appears. The seed leaves spread out as the stem elongates. Within a few days, the first true leaves appear, and the little plant is now officially a seedling. This growth stage lasts for three to six weeks. During seedling growth, a root system grows rapidly while green aboveground growth is slow. Water and heat are critical at this point of development. The new, fragile root system is very small and requires a small but constant supply of water and warmth. Too much water will drown roots, often leading to root rot and damping-off. Lack of water will cause the infant root system to dry up. As the seedlings mature, some will grow faster, stronger, and appear healthy in general. A little heat now will help nurture small seedlings to a strong start. Other seeds will sprout slowly and be weak and leggy. Cull sickly, weak plants, and focus attention on the remaining strong survivors. Seedlings should be big enough to thin out by the third to fifth week of growth. Thinning out seedlings is very difficult for growers who pay \$300 dollars for a few seeds!

Seedlings need at least 16 hours of light daily. They require less intense light now and grow well under fluorescent tubes for the first two to three weeks. Compact fluorescent and HID light can also be used. The compact fluorescent should be 12-18 inches (30-45 cm) and the HID 3-4 feet (90-120 cm) above seedlings for best growth.

The seedling stage is over when rapid foliage growth starts. Rapid growth above ground is the beginning of the vegetative growth stage. Plants need more room to grow; transplanting into a larger container hastens development.



Seedlings emerging from peat pots develop seed (cotyledon) leaves before growing their first set of "true leaves."



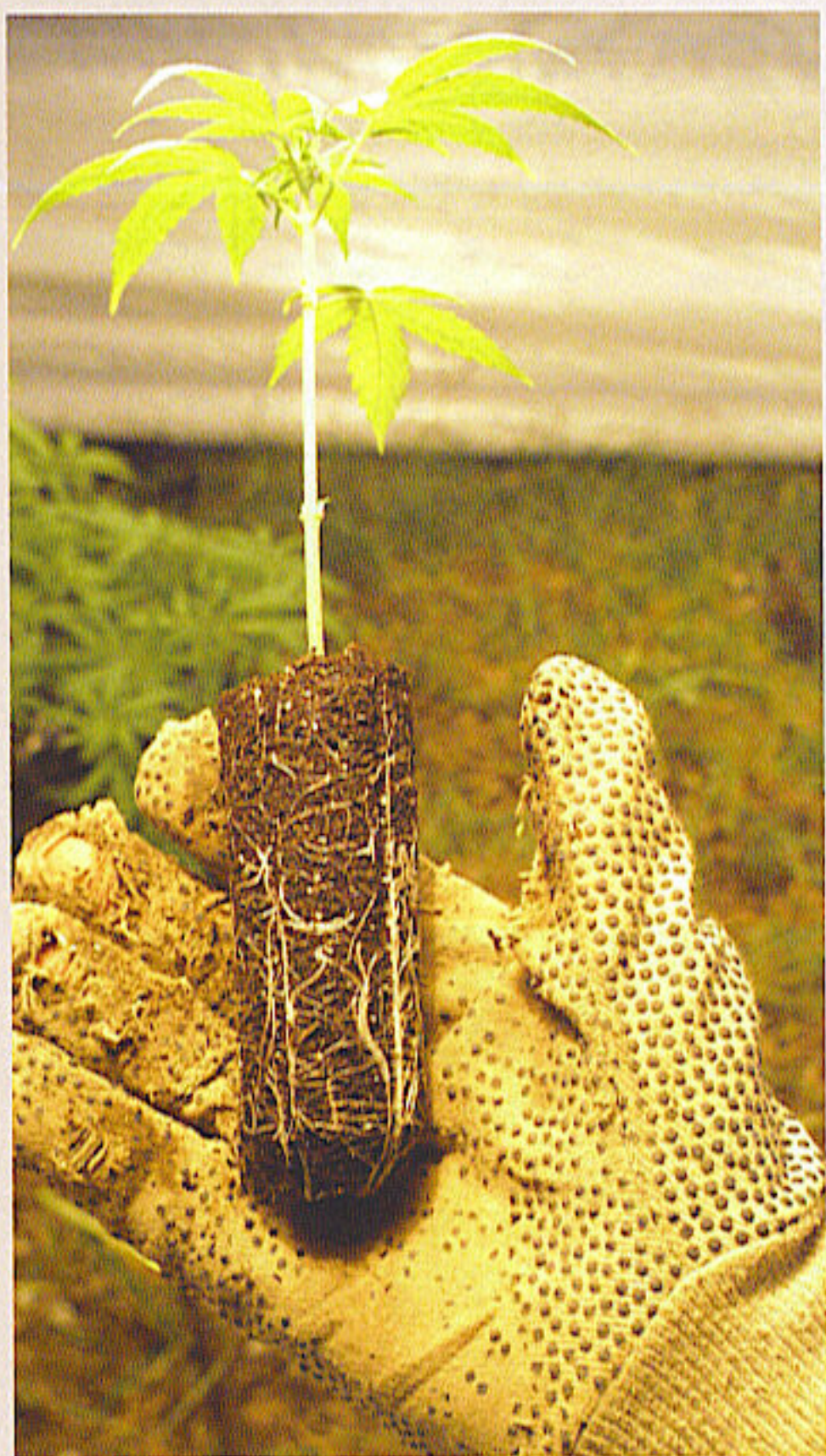
'Blue Satellite' seedlings are flourishing in this Styrofoam cup. They were transplanted the day the photo was taken.



Strong, healthy seedlings like this 'White Widow' are the key to a heavy harvest.



Small 'Thaitanic' is at the end of the seedling stage of growth.



Deep plugs grow a deeper root system. This seedling was transplanted outdoors and grew very well.

Ordering Seeds

Ordering seeds via a magazine ad or the Internet is commonplace. Many reputable companies advertise. You are most secure to order from a company you can contact by telephone. Speak to a qualified representative who will provide good answers to your questions. Companies with an e-mail address and web site are usually okay to order from, but make sure they answer your e-mails promptly. Do not be afraid to call several companies and ask them specific questions about the strains they sell. If you live in a country where seeds are illegal, call from a

public telephone and use a calling card. Do not call the seed company from a telephone located at a grow house.

Communicating via e-mail can leave a trail to the computer if you do not use a proxy server. Check out www.overgrow.com for more information on how to set up and use proxy servers.

Some seed companies produce their own seed and sell it directly to the public. Most seed producers sell their seed to a reseller such as www.kindseed.com, www.theamsterdam.com, or www.hempqc.com (Heaven's Stairway).

Check the "StrainGuide" on www.overgrow.com to find more information about growing specific strains. Once you decide on what to order and have communicated with the company, you are ready to place your order. Do not use a credit card if security is a concern. Companies normally bill your credit card discreetly and do not charge your credit card with "Cannabis Seeds." However, if you decide to use a credit card, discuss the matter with the retailer. You may decide to use an international money order. Cash tells no tales and leaves no trails. Wrap the cash in carbon paper so that it cannot be seen. Allow a reasonable amount of time, two to four weeks, for the order to arrive. Do not forget that sometimes packages are lost, misplaced, and mislabeled.

You may want to set up a "safe address" such as a PO Box under an assumed name. Hit Green Man's page, <http://www.seedbankupdate.com>. He regularly updates the page and lists seed companies' performance levels.

If US Customs seizes your order of seeds, they will send you a note informing you of that fact. We have never heard a report of a law enforcement official showing up at your door.

Buy ten seeds, and germinate half of them at once. Then, when and if they germinate, start the rest of the seeds.



Boy Ramsahai, owner of High Quality Seeds and Black Label Seeds, shows off his high-tech refrigerator for seed storage. The refrigerator keeps humidity levels below five percent to ensure safe long-term storage.

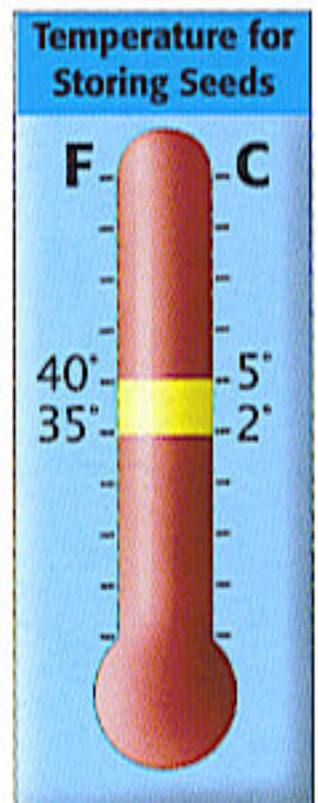
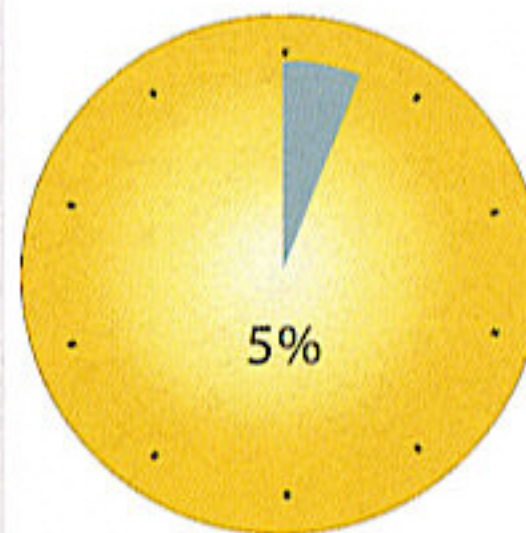
Storing Seeds

Store seeds in a cool, dark, dry place. Make sure to label containers! Some seeds will remain viable for five years or longer when stored properly. When 50 percent of the stored seeds do not germinate, the average storage life is over. But seeds a year old or older often take longer to sprout and have a lower rate of germination.

Seed hormones—ABA, cytokinins, and gibberellins—are primed to respond to moisture, which is the first signal to germinate. Prevent moisture from signaling seeds to germinate by keeping them dry. Small amounts of moisture in the form of condensation can give seeds a false start on germination and cause them to expend all their stored energy. Avoid moisture levels above five percent to ensure viable seed. Moisture levels above five percent will cause germination levels to decrease rapidly. Seal seed in an airtight container, and place silicon crystal packages in the container to absorb excess moisture.

Cannabis seeds need enough moisture to initiate this process within 48 hours.

Humidity



Seeds store for a long time when humidity is less than 5 percent and temperature is 35-40° F (2-5° C).



Dry seeds are temperature-sensitive; they can be disinfected with a short application of heat. Low temperatures slow internal seed activity so are best for preserving seeds. You can use super-cold liquid nitrogen and cryogenics to store seeds for a long time.

Air, once it enters the outer seed shell, signals seeds to germinate. Viable seeds are preserved longer when vacuum-packed to remove all oxygen.

Seeds with a thin, outer protective shell never truly go dormant, because moisture and air are always present within. This moisture and air cause hormone levels to slowly dissipate. Such seeds do not store well for a long time.

Seed Pests

Seed pests become active when there is more than ten percent moisture content. When the growing medium contains more than fifteen percent moisture, fungi become active. Excess fertilizer slows seedling growth and promotes fungus attacks.

Temperatures from 68-85°F (20-30°C) promote Pythium (damping-off) and rhizoctonia fungi. Cannabis seeds grow best at 78°F (25°C). Most fungi reproduce fastest in a temperature range of 68-86°F (20-30°C).

Keep a wary eye on problems. Nutrient overdose burns leaf tips and fringes, which can look like damping-off to the untrained eye. Do not fertilize. Applying a fungicide now will make the problem worse.



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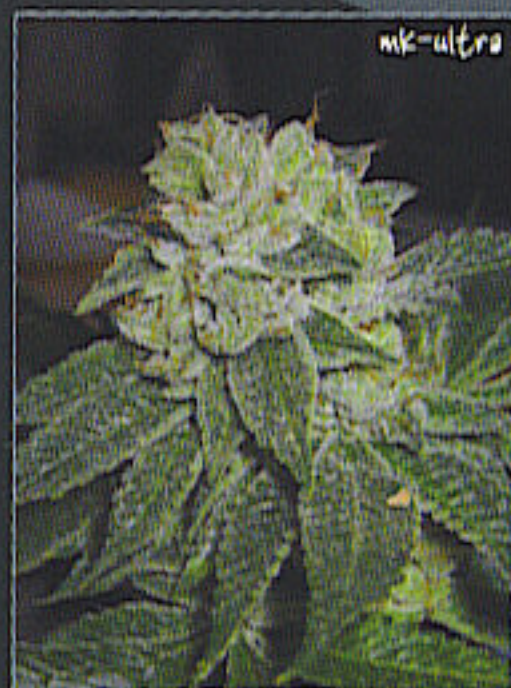


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Store seeds in an airtight plastic bag inside a film container. Use a heat-sealed container if storing seeds for more than a couple of months. Place a packet of silicone in the container to absorb excess moisture.

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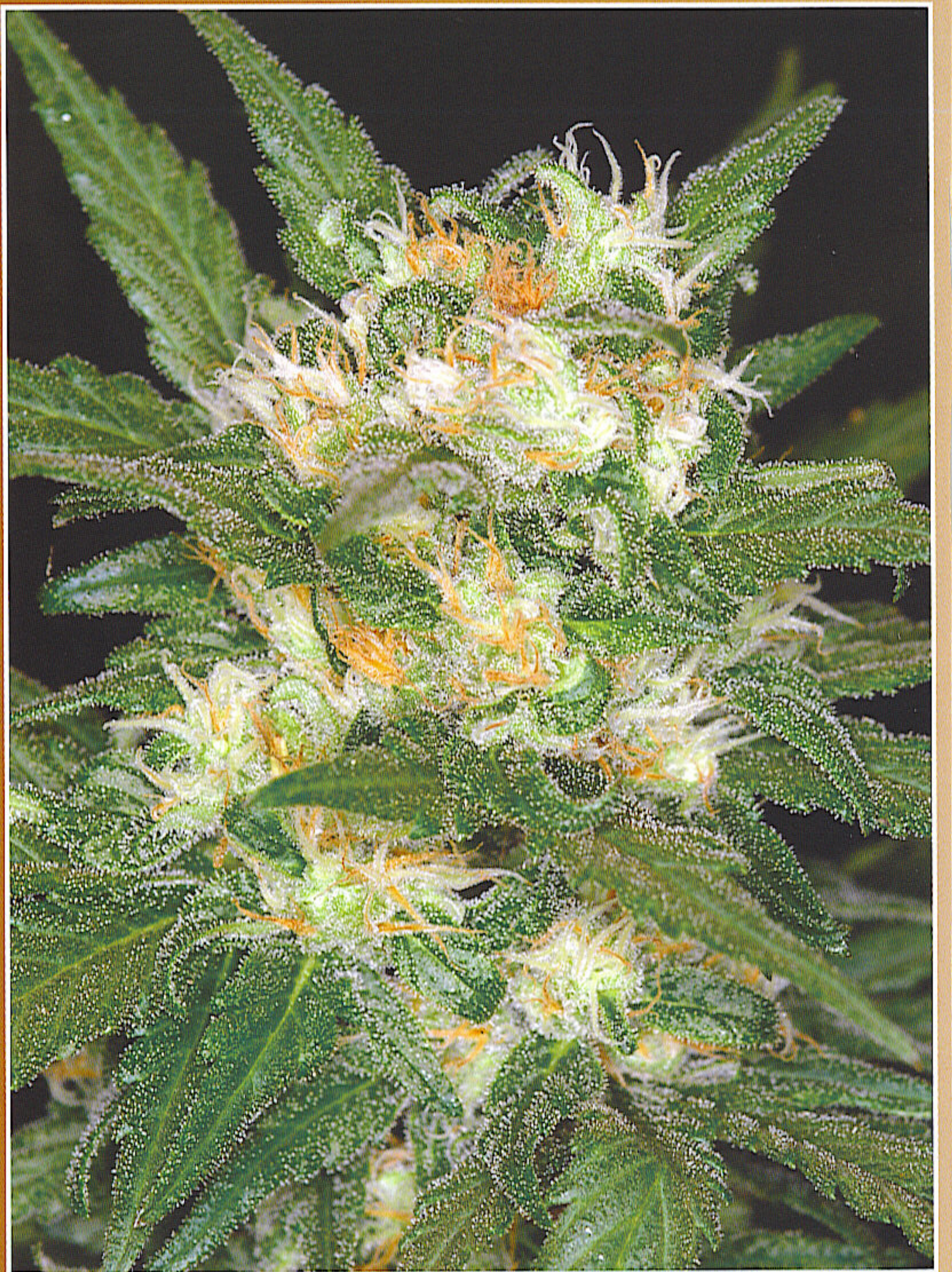
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Cannabis Trade Shows

There are a number of trade shows being held around the world at various times of the year. These places are an excellent source for high-tech grow techniques with seminars and lectures by noted growers. Visit these shows to see cannabis industry grow products, including seeds, and equipment.



Goyo points out a leaf that police painted gold at the CannaTrade Fair in Bern, Switzerland.



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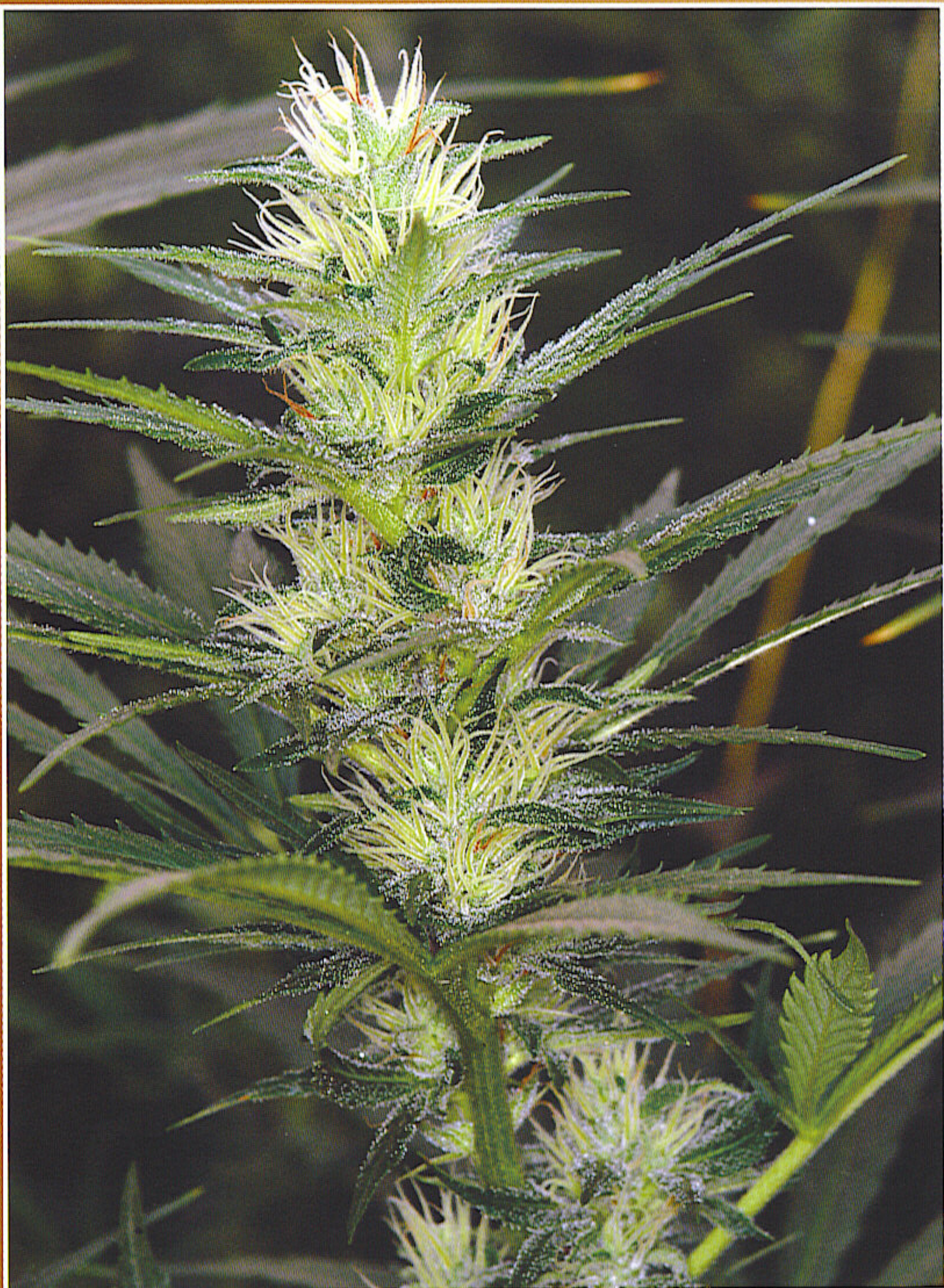
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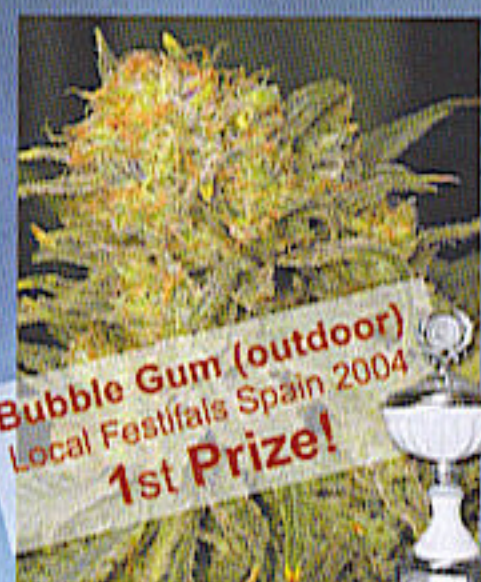


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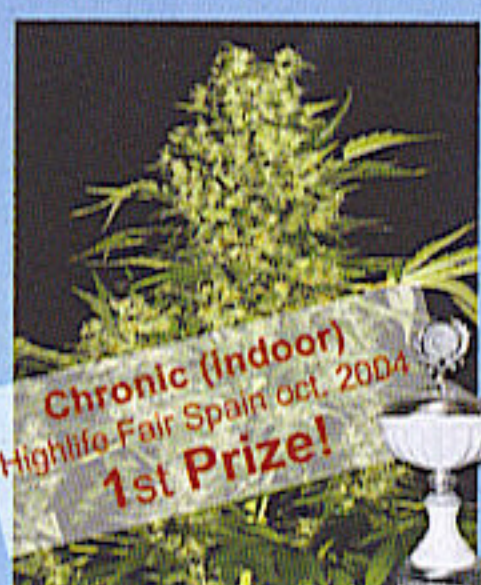
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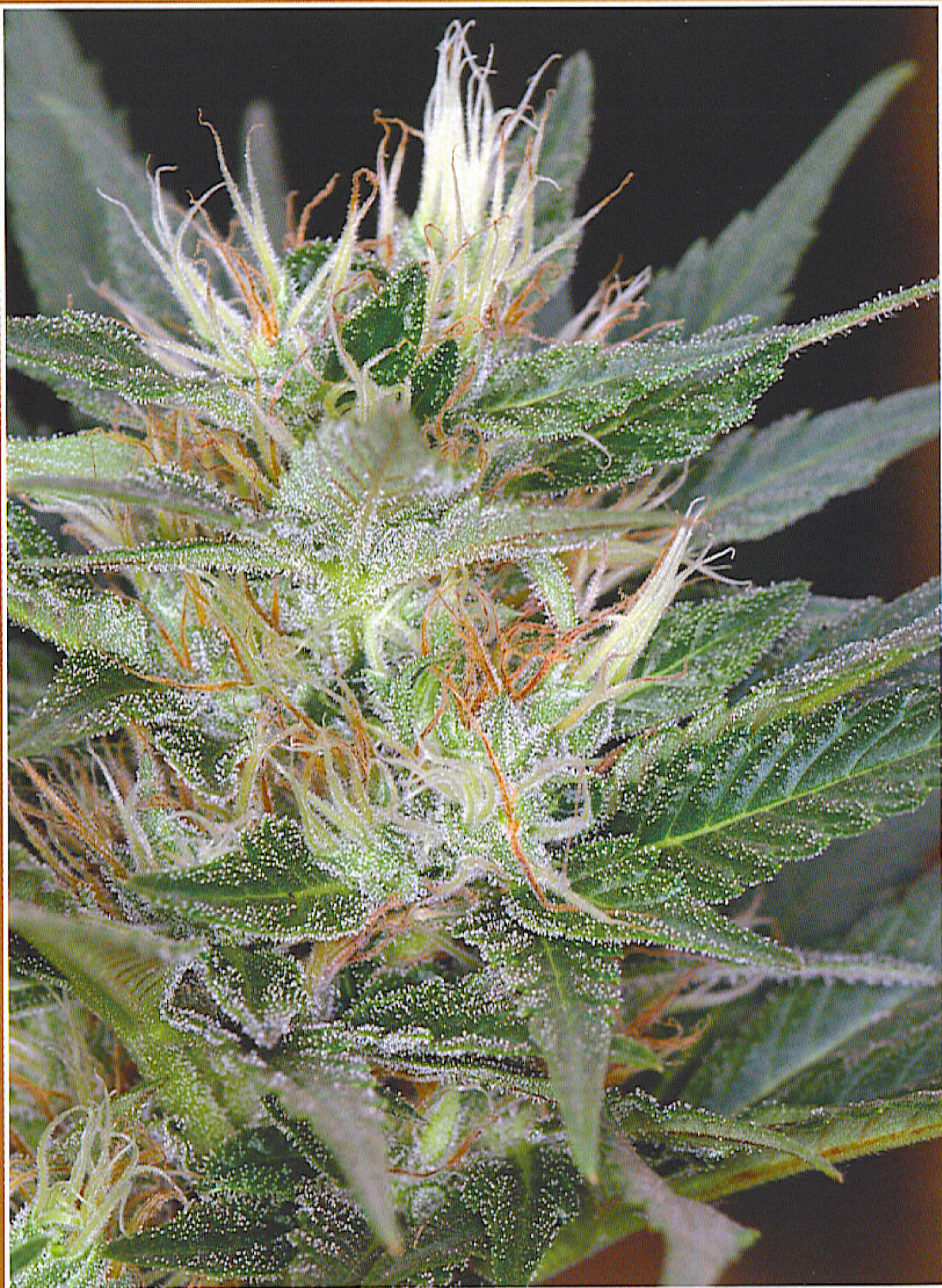
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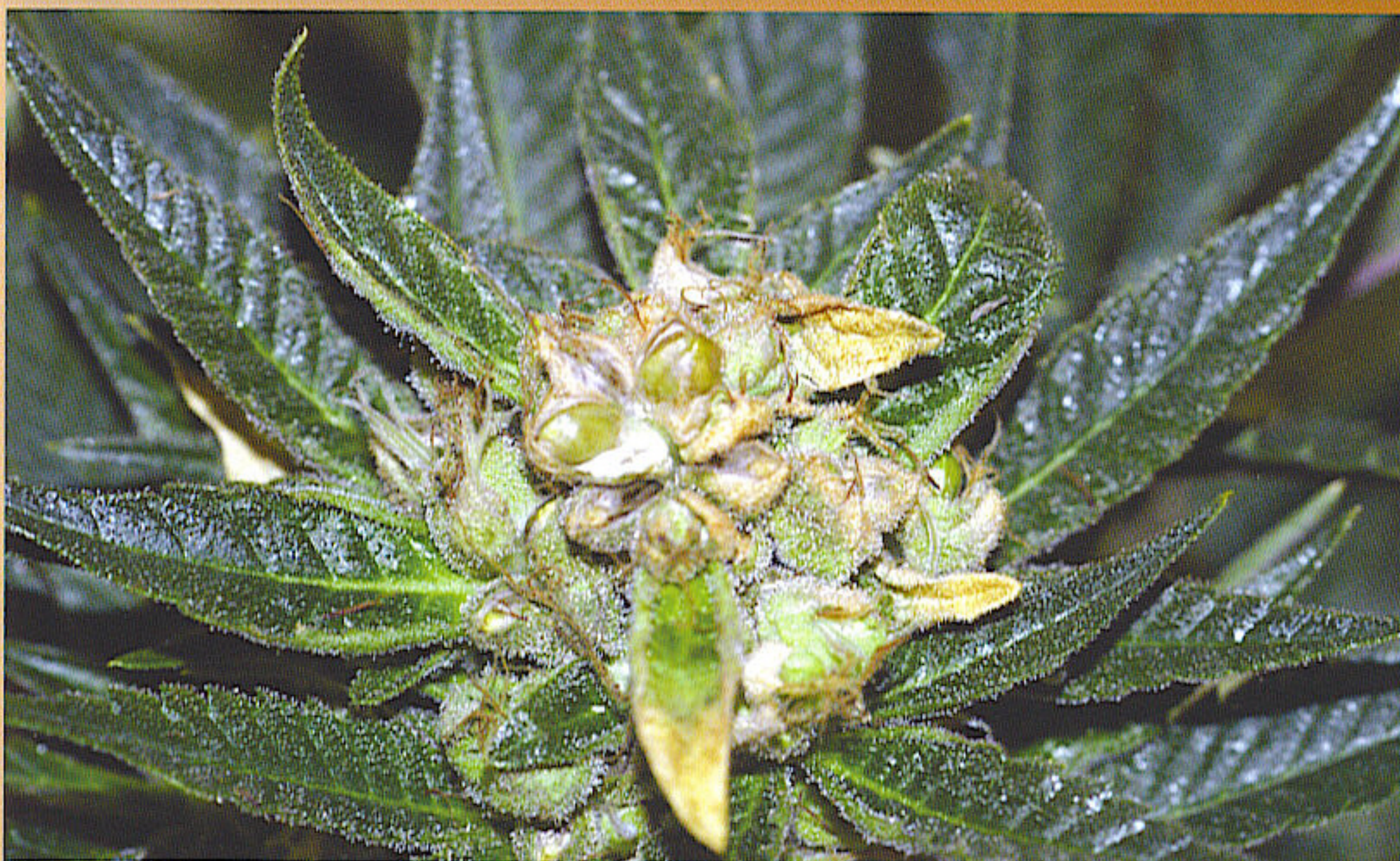
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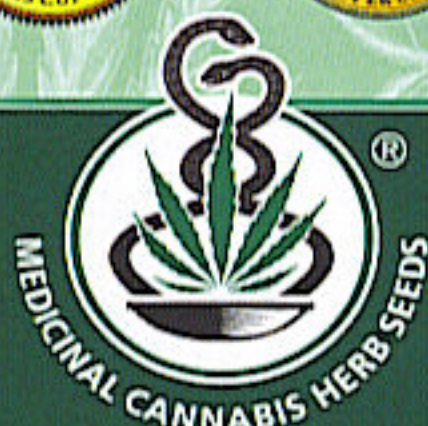
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Chapter TWO

SEEDS



Grow out as many seedlings as possible to select the best mothers.

Chapter THREE

VEGETATIVE GROWTH



Strong, healthy vegetative growth is the key to a heavy harvest.

Introduction

The seedling growth stage lasts for about two to three weeks after seeds have germinated. Once a strong root system is estab-



This seedling is in the early stages of vegetative growth.



This 'Euphoria' female has been in the vegetative growth stage for more than two months.

lished and foliage growth increases rapidly, seedlings enter the vegetative growth stage. When chlorophyll production is full speed ahead, a vegetative plant will produce as much green, leafy foliage as it is genetically possible to manufacture as long as light, CO₂, nutrients, and water are not limited. Properly maintained, marijuana will grow from one-half to two inches per day. A plant stunted now could take weeks to resume normal growth. A strong, unrestricted root system is essential to supply much needed water and nutrients. Unrestricted vegetative growth is the key to a healthy harvest. A plant's nutrient and water intake changes during vegetative growth. Transpiration is carried on at a more rapid rate, requiring more water. High levels of nitrogen are needed; potassium, phosphorus, calcium, magnesium, sulfur, and trace elements are used at much faster rates. The larger a plant gets and the bigger the root system, the faster the soil will dry out. The key to strong vegetative growth and a heavy harvest is supplying roots and plants with the perfect environment.

Vegetative growth is maintained with 16 or more hours of light. I used to believe a point of diminishing returns was reached after 18 hours of light, but further research shows that vegetative plants grow faster under 24 hours of light. Marijuana will continue vegetative growth a year or longer (theoretically forever), as long as an 18-hour photoperiod is maintained.

Cannabis is photoperiodic-reactive; flowering can be controlled with the light and dark cycle. This allows indoor horticulturists to control vegetative and flowering growth. Once a plant's sex is determined, it can become a mother, clone, or breeding male, and can be harvested or even rejuvenated.

Note: Plants show early male or female "pre-flowers" about the fourth week of vegetative growth. See "Pre-flowering" in Chapter Four and the sections here on pre-flowering male and female.

Cloning, transplanting, pruning, and bending are all initiated when plants are in the vegetative growth stage.

Clones and Cloning

Marijuana can be reproduced (propagated) sexually or asexually. Seeds are the product of sexual propagation; cuttings or clones are the result of asexual or vegetative propagation. In its simplest form, taking a cutting or clone involves cutting a growing branch tip and rooting it. Technically, cloning is taking one cell of a plant and promoting its growth into a plant. Marijuana growers commonly refer to a clone as meaning a branch of a cannabis plant that has been cut off and rooted.

Cloning reduces the time it takes for a crop to mature. Productive growers have two rooms, a vegetative/cloning room, about a quarter the size of a second room used for flowering. Smaller vegetative plants take up less space than older flowering plants. For example, a 250- or 400-watt metal halide could easily illuminate vegetative plants and clones that would fill a flowering room lit by three 600-watt HP sodiums. If the halide is turned off, fluorescent and compact fluorescent lamps are more economical and work well to root clones.

Combine eight-week flowering/harvest cycles with continuous cloning to form a perpetual harvest. One easy-to-implement scenario is to take two clones every four days, and harvest one ripe female every other day. Every time a plant is harvested, one or two rooted clones are moved from a constantly supplied vegetative room into the flowering room. This regimen gives a grower 30 flowering clones that are on a 91-day schedule. It takes 91 days from the time a clone is cut from the mother plant until the day it is harvested. Using this schedule, a grower would have 30 clones, 10 vegetative plants, and 30 flowering plants growing at all times. See chart next page.



Swiss retailers sold clones over-the-counter until the law changed in 2001. Now, Swiss growers have gone underground.



Clone production room in the basement of a Swiss retail store.

Growth Stage	Time	Number of plants
Clone	3 weeks	30
Vegetative	2 weeks	10
Flower	8 weeks	30
	Total	70



A sea of clones share all genetic characteristics. They will all grow up to look like their mothers.



Two 'Queen Mother' plants will soon bear many, many clones.

Induce clones to flower when they are four to twelve inches tall to make most efficient use of HID light. Artificial light diminishes to the square of the distance, which means that *foliage four feet away from the bulb receives one fourteenth as much light as if it were one foot away!* Foliage that is shaded or receives less light grows slowly and looks spindly.

Short crops of clones in small containers are much easier to move and maintain than big plants in big containers. Short clones are also easy and efficient to grow in greenhouses and outdoors.

Well-illuminated, strong clones grow fast and have less chance of being affected by pests and diseases. Fast-growing clones develop more quickly than spider mites can reproduce. By the time a spider mite infestation is noticed and sprayed, the plants are a few weeks from harvest. Clones are also easy to submerge in a miticide when small.

Experiments with clones are consistent and easy to control. Genetically identical clones respond the same to different stimuli, such as fertilizer, light, bending, etc. After experimenting on several crops of clones from the same mother, a grower has a very good idea what it takes to make them grow well.

Mother Plants

Any plant can be cloned, regardless of age or growth stage. Take clones from mother plants that are at least two months old. Plants cloned before they are two months old may develop unevenly and grow slowly. Clones taken from flowering plants root quickly but require a month or longer to revert back to vegetative growth. Such rejuvenated clones occasionally flower prematurely, and buds are more prone to pest and disease attacks.

Any female can become a mother. She can be grown from seed or be a clone of a clone. I interviewed several growers who made

clones of clones more than 20 times! That is, clones (C-1) were taken from the original female grown from seed. These clones were grown in the vegetative stage, and clones (C-2) were taken from the first clones (C-1). Blooming was induced in (C-1) two weeks later and (C-2), grown in the vegetative stage. Then, clones (C-3) were taken from the second clones (C-2). This same growing technique is still going on with clones of clones well past (C-20) and there has been no apparent breakdown in the potency or the vigor of the clone. However, if mothers suffer stress, they produce weak clones. Mothers that are forced to flower and revert back to vegetative growth not only yield less, they are stressed and confused. Clones that grow poorly are generally the result of poor, unsanitary cloning practices.

A clone is an exact genetic replica of the mother plant. Each mother's cell carries a DNA blueprint of itself. Radiation, chemicals, and poor cultural practices can damage this DNA. Unless damaged, the DNA remains intact.

A female plant will reproduce 100 percent females, all exactly like the mother. When grown in the exact same environment, clones from the same mother look alike. But the same clones subjected to distinct environments in different grow rooms will often look different.

A six-month old plant produces more cannabinoids than a one-month old plant. By cloning, a horticulturist is planting a THC-potent plant that will continue to grow in potency at a very rapid rate. A month-old rooted clone acts exactly like a four-month-old plant and can be induced easily to flower with a 12-hour photoperiod.

Keep several mother plants in the vegetative stage for a consistent source of cloning stock. Start new mothers from seed every year. Give mother plants 18-24 hours of light per day to maintain fast growth. For best

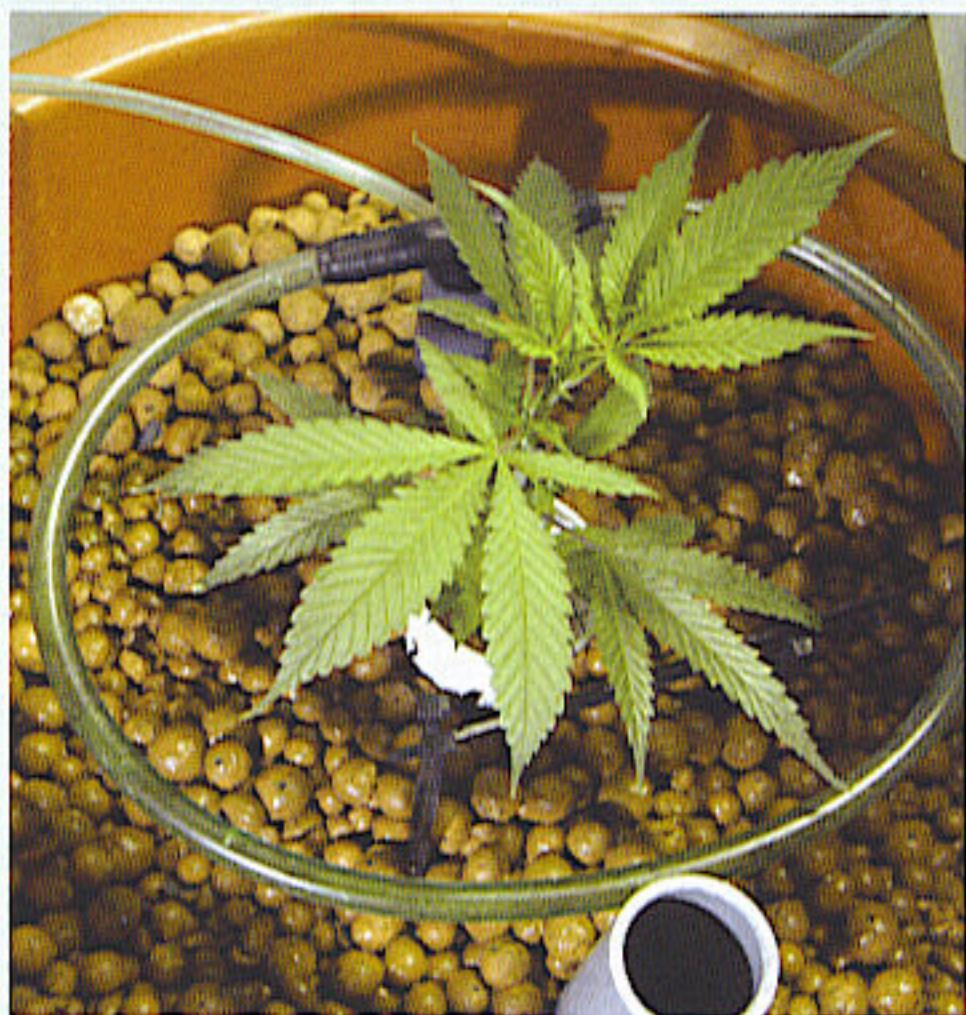


This young 'Shaman' has already shown female pre-flowers and can become a mother plant.



Swiss greenhouse grower nurtures clones in lower beds and keeps mothers in bright light in upper bed.

results, give mothers about ten percent less nitrogen, because less nitrogen promotes rooting in clones.



Young mother plant is given the best of care. A few weeks ago, this clone was taken from a mother plant.



Mother plants must stay very healthy to be able to produce many clones. The roots on this mother are very healthy!



Mother plants are growing in large, individual hydroponic containers for easy culture and maintenance.



The root system on this heavily producing mother plant is white—very strong and healthy.

Integrity in parents:

1. Maintain 18-24-hour day photoperiod
2. Keep plants healthy
3. Grow for 6-9 months
4. Repot
5. Grow hydroponically

es. See drawing on previous page. A rigid branch that folds over quickly when bent is a good sign of high carbohydrate content.

Hormone content is different in different parts of a plant. Root growth hormones are concentrated near the base of the plant close to the main stem. This is the oldest portion of the plant and is where most root hormones are located. The top of the plant contains older hormones; cuttings taken from this part root slowly.

While rooting, clones require a minimum of nitrogen and increased levels of phosphorus to promote root growth. Sprays should be avoided during rooting as they compound cloning stress. Given good instruction and a little experience, most growers achieve a consistent, 100 percent clone survival rate.

Large cuttings with large stems packed with starch grow roots slower than small clones with small stems. The excess starch in moist substrate also attracts diseases. Thin-stemmed clones have fewer reserves (accumulated starch), but they only need enough reserve energy to initiate root growth.

Small clones with few leaves root faster than big cuttings with many leaves. At first leaves contain moisture, but after a few days, the stem is no longer able to supply enough moisture to the leaves, and the clone suffers stress. A small amount of leaf space is all that



These 'Ortega' clones were taken on August 25. Now they are rooted and ready to transplant.

	Cut from Young	Cut from Old
Cell division starts	Day 4	Day 6
First root nubs form	Day 6	Day 10
Roots start to grow	Day 7	Day 20
Enough roots to transplant	Day 14	Day 28

This chart shows average times for roots to grow from the cambium. Note clones taken from younger growth root about twice as fast as those taken from older growth.

Negative points

Clones grow slower than F1 hybrid plants grown from seed. An F1 hybrid is the heterozygous first filial generation—pollen and ovule. F1 hybrids have "hybrid vigor" which means that this cross will grow about 25 percent bigger and stronger than cuttings. Hybrid vigor also makes plants less susceptible to pest and disease problems.

Always start with the best mothers you can find. A mother plant yields clones in her image. If the mother plant lacks potency, harvest weight, or is not pest and disease resistant, the clone shares her drawbacks. These weaknesses are compounded when growing only one strain. An unchecked pest or disease infestation could wipe out the entire crop.

Some growers have a difficult time learning to make clones. If this is the case, continue to work through the little problems one step at a time, and you will learn. Some people have a little longer learning curve when cloning is involved. Take five to ten practice clones before making a serious cloning. You can also work with strains that are easy to clone, as illustrated in the chart below.

Plants that are easy to clone

Most Skunk and Indica strains are easy to clone.

Growers and sick plants cause most clone rooting problems. Weak plants that lack vigor provide slow-rooting weak clones. Poor growing conditions also affect clone strength.

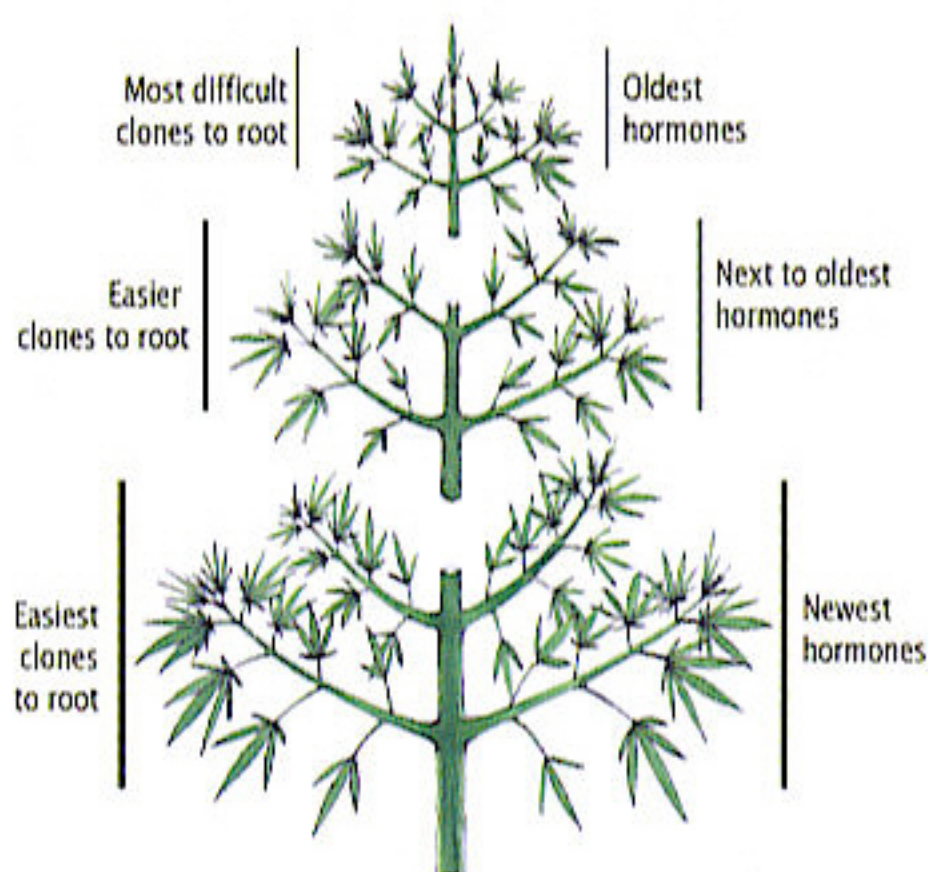
Harder to clone:

Ruderalis Indica and Ruderalis Skunk do not make suitable mother plants due to their auto-flowering capability. Outdoor strains with a slight tendency to pre-sex in an 18hr photoperiod include: Early Girl, Early Skunk and many others. Check with seed companies for details. But early flowering does not exclude them as mother plants.

Getting Ready

Cloning is the most traumatic incident cannabis plants can experience. Clones go through an incredible transformation when they change from a severed growing tip to a rooted plant. Their entire chemistry changes. The stem that once grew leaves must now grow roots in order to survive. Clones are at their most tender point in life now.

Clones quickly develop a dense system of roots when stems have a high carbohydrate and low nitrogen concentration. Build carbohydrate levels by leaching the growing medium with copious quantities of water to flush out nutrients. The growing medium must drain very well to withstand heavy leaching without becoming waterlogged. Reverse foliar feeding will leach nutrients from leaves, especially nitrogen. To reverse foliar feed, fill a sprayer with clean water and mist mother heavily every morning for three or four days. Older leaves may turn light green; growth slows as nitrogen is used and carbohydrates build. Carbohydrate and hormonal content is highest in lower, older, more mature branch-



Clones from lower branches root the easiest because they contain more of the proper hormones.

Rooting Hormone	Contents	Notes
Algimin® Maxicrop	Dry kelp product Liquid seaweed	NO IBA or NAA. Soak cuttings overnight in a solution of two ounces Algimin® to one gallon of water. After planting, continue watering with this solution.
Clonex®	First cloning gel	Blend of seven vitamins, eleven minerals, two anti-microbial agents, 3000 ppm rooting hormones. Gel seals cutting tissues, reducing chance of infection and embolisms.
Dip-N-Grow® Earth Juice Catalyst®	IBA, NAA, anti-bacterial	Cost is one penny per 100 cuttings. Organic, derived from oat bran, kelp, molasses, vitamin B complexes, amino acids, hormones, and low levels of nutrients.
Hormex	IBA based powder	Available in six different strengths ranging from 1000 ppm to 45,000 ppm.
Hormodin®	IBA	Powder available in three strengths: 1000, 3000, and 8000 ppm.
Nitrozyme®	Natural product	Seaweed extract, contains cytokinins, auxins, enzymes, gibberellins, and ethylenes. Spray Nitrozyme on mothers two weeks before taking cuttings.
Olivia's Cloning Solution® Olivia's Cloning Gel	IBA, anti-fungal agents, nutrients	Very high success rate.
Rhizopon AA® (Rhizopon B.V.)	IBA	World's largest company devoted to research and manufacture of rooting products. Powder and water-soluble tablets in strengths from 500 to 20,000 ppm.
Rootex	IBA vitamins, hormones	From Tecknaflora is one of the favorite products in North America.
Vita Grow	IBA NAA.	Customers say "you could root a popsicle stick"
Warning! Some products are not recommended for use with edible plants. Read the label carefully before deciding to use a product.		

Liquid rooting hormones can be mixed in different concentrations. Always mix the most dilute concentration for *softwood* cuttings. Apply any rooting hormone containing IBA *only once*. If exceeded in concentration or duration, IBA applications impair root formation. As soon as cuttings are taken, clones start dispatching rooting hormones to the wound. They arrive in full force in about a week. The artificial rooting hormone fills the

need until natural hormones take over.

Give cuttings a 5-15 second dip in concentrated solutions of IBA and NAA, 500-20,000 ppm. With a quick dip, stems evenly absorb the concentrated hormone.

Relatively new to the market, gels have caught on everywhere. They are easy to use and practical, but are not water soluble. Once applied, gels hold and stay with the stem longer than liquids or powders.

is necessary for photosynthesis to supply enough energy for root growth.

Precautions

An embolism is a bubble of air that gets trapped in the hole in the stem. Embolisms occur when you take big clones and lay them on the counter before placing in water or a growing medium. When an embolism happens, fluid flow stops, and clones die. After taking cuttings, immediately dip them in water or a growing medium to prevent air from getting trapped in the hollow stems. Eliminate the threat of an embolism by taking cuttings under water.

Clones root well within a pH range of five to six. Aeroponic clone gardens normally do best with a pH of five to five and a half. Most diseases grow poorly below these pH levels. Always make sure there is plenty of air in the rooting medium; this will stimulate root growth.

Do not kill clones with kindness and fertilizer. At best, giving clones an excess dose of fertilizer causes rooting to be delayed. In fact, a good dose of ammonium nitrate, a common fertilizer, will stop root hairs from growing.

If an infestation occurs, apply aerosol pyrethrum. Remember, all pesticides, natural or not, are phytotoxic. Spraying cuttings is a bad idea in general. If you must use sprays, use natural organic sprays, apply them when it is cool, and keep their use to a minimum.

Use anti-desiccant sprays sparingly, if at all, and only if a humidity dome is unavailable. Anti-desiccant sprays clog stomata and can impair root growth in clones.

Do not over-water clones. Keep the medium evenly moist, and do not let it get soggy.

Any kind of stress disrupts hormones and slows rapid growth.

Keep the cloning area clean. Do not take clones where fungus spores and diseases are hiding! Pythium is the worst! Pythium flourishes in high temperatures and excessive moisture. Mites, whiteflies, thrips, etc., love



Do not use fertilizers on clones or seedlings.

weak tender clones. Remove infested clones from the room. Cooler conditions, 65-78°F (18-25°C), slow mite and fungal spore reproduction and allow you to avert an infestation.

Rooting Hormones

Root-inducing hormones speed plant processes. When the stem of a cutting develops roots, it must transform from producing green stem cells to manufacturing undifferentiated cells and, finally, to fabricating root cells. Rooting hormones hasten growth of undifferentiated cells. Once undifferentiated, cells quickly transform into root cells. Three substances that stimulate undifferentiated growth include naphthalenaecetic acid (NAA), indolebutyric acid (IBA) and 2, 4-dichlorophenoxyacetic acid (2, 3 DPA). Commercial rooting hormones contain one, two, or all of the above synthetic ingredients and often include a fungicide to help prevent damping-off.

Rooting hormones are available in liquid, gel, or powder form. Liquid and gel types penetrate stems evenly and are the most versatile and consistent. Powdered rooting hormones adhere inconsistently to stems, penetrate poorly, spur uneven root growth, and yield a lower survival rate.

Rooting powders are a mixture of talc and IBA and/or NAA and are less expensive than liquids or gels. To use, roll the moistened end of your cutting in the powder. Apply a thick, even coat. To avoid contamination, pour a small amount into a separate container, and throw away any excess. Tap or scrape excess powder off the cutting; excess hormones can hinder root growth. Make a hole bigger than the stem in the rooting medium. If the hole is too small, the rooting powder gets scraped off upon insertion.

You can also spray clones with a single foliar spray of dilute IBA (50-90 ppm). Be careful to spray just enough to cover leaves. Spray should not drip off leaves. An IBA overdose slows growth, makes leaves dwarf, and could even kill the clone.

Some growers soak their cuttings in a dilute solution (20-200 ppm IBA and/or NNA) for 24 hours. But I have seen few growers use this time consuming technique.

To determine the rooting hormone concentration in parts per million, multiply the percentage listed by the manufacturer by 10,000. For example, a product with 0.9% IBA contains 9000 ppm IBA.

An all-natural, root-inducing substance is willow (tree) water. The substance in all willow trees that promotes rooting is unknown, but repeated experiments have proven willow water promotes about 20 percent more roots than plain water. This willow water is mixed with commercial rooting hormones for phenomenal results.

To make willow water rooting compound, find any willow tree and remove some of this year's branches that are about one and a half inches in diameter. Remove the leaves, and cut the branches into one-inch lengths. Place one-inch willow sticks on end, so a lot of them fit in a water glass or quart jar. Fill the jar with water, and let it soak for 24 hours. After soaking, pour off the willow water, and use it for rooting hormone. Soak the marijuana clones in the willow water for 24 hours,



Cloning gels are very popular because they keep root-inducing hormones evenly distributed along the subterranean stem.

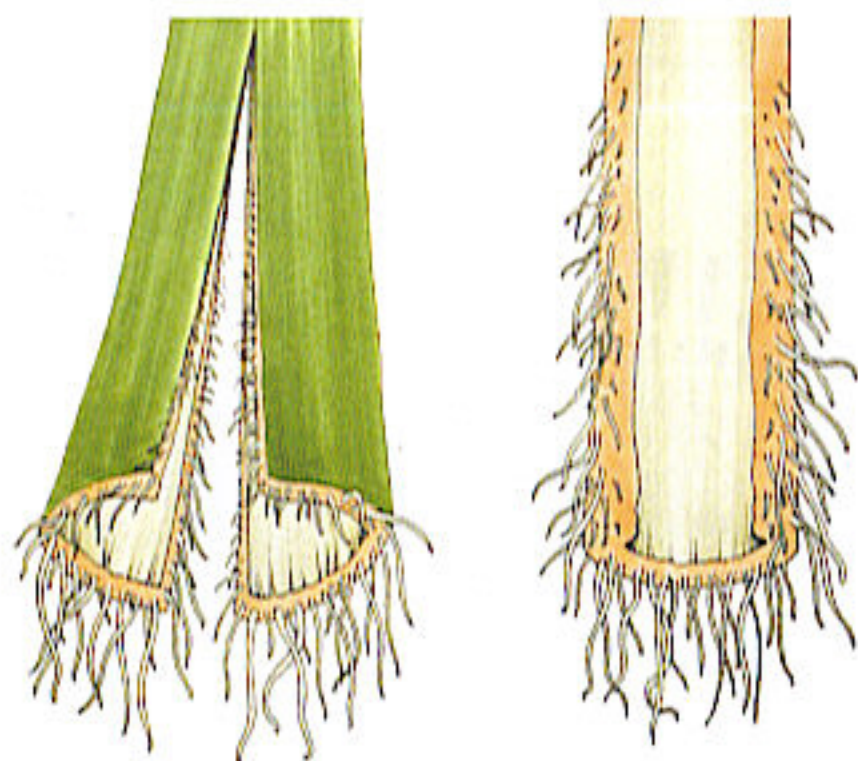


Get all cloning supplies ready before starting.

then plant in rooting medium. If using a commercial liquid rooting hormone, substitute the willow water in place of regular water in the mix.

Canna products and several other commercial products contain Trichoderma bacteria. The bacterium causes roots to grow and absorb nutrients better. To learn more about

Grow More Roots



Split the stem of clones to expose more of the cambium layer just under the "skin" of the stem. It is the only place that generates new roots.

Exposing the cambium layer causes many roots to grow there. Lightly scraping away the outer layer of the stem to expose only the cambium allows hormones to concentrate where roots start. Splitting the clones' stem exposes more surface area to grow roots. Both practices increase the number of healthy roots, but rooting time is a few days longer.

After the cutting has been trimmed and scraped, dip the bare stem into a rooting hormone. Now it is ready to "stick" into the substrate.

Split the stem to initiate more surface area for roots to grow.



Avoid problems:

Keep the work area clean. Wash work surfaces and tools before starting.

Have grow medium ready.

Prepare mother plant (scion).

Take clones.

Store unused clone.

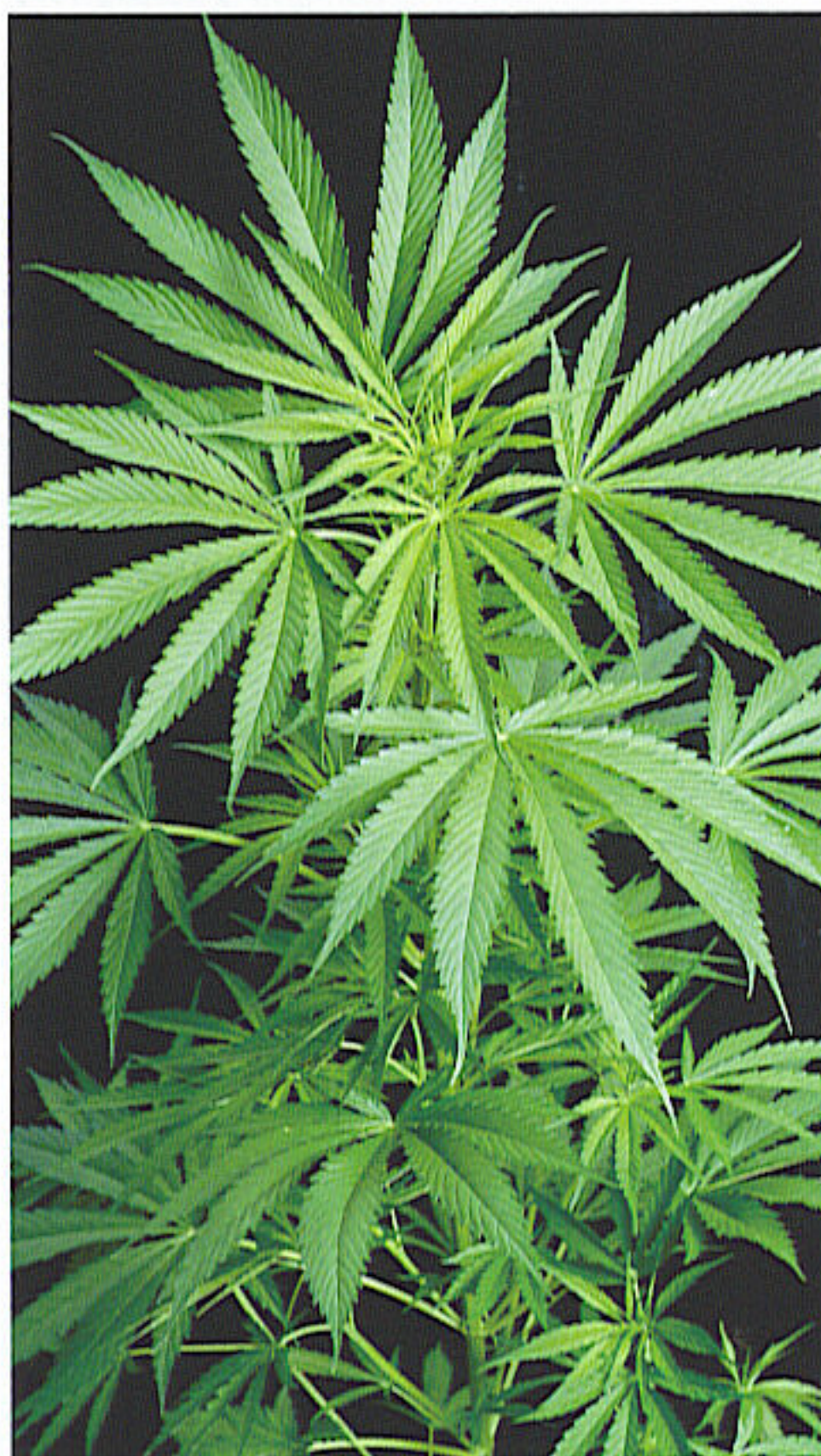
Insert (stick) cutting in growing medium or aeroponics system.

Place clones under humidity tent.

Look for root growth.

Transplant when roots emerge from root cube or medium.

Harden-off by gradually exposing to new environment.



This beautiful 'Stinky Pinky' mother is just two and a half months old.

it, check out the Canna web site www.canna.com.

Before Making Clones

Making clones or cuttings is the most efficient and productive means of cannabis propagation for small growers, both indoors and out. Once females have been distinguished, you are ready to practice the simple, productive art and science of cloning.

Disinfect all tools and working surfaces to kill bacteria, fungi, viruses, and other diseases already present. Use sharp scissors, razor, or razor blade dipped in alcohol, vinegar, or bleach (five to ten percent solution). Wash your hands thoroughly beforehand.

Make sure to have all cloning supplies within arm's reach—rooting cubes, hormone, razor or scissors, humidity dome, etc.—before you start to take clones.

Cloning: Step-by-Step

Step One: Choose a mother plant that is at least two months old. Some varieties give great clones even when pumped up with hydroponics and fertilizer. If a variety is difficult to clone, leach the soil with two gallons of water for each gallon of soil every morning for a week before taking clones. Drainage must be good. Or mist leaves heavily with plain water every morning. Both practices help wash out nitrogen. Do not add fertilizer.

Step Two: With a sharp blade, make a 45-degree cut across firm, healthy 0.125-0.25-inch-wide (3-6 mm) branches, two to four inches (3-5 cm) in length. Take care not to smash the end of the stem when making the cut. Trim off two or three sets of leaves and growth nodes so the stem can fit into the soil. There should be at least two sets of leaves above the soil line and one or two sets of trimmed nodes below ground. When cutting, make the slice halfway between the sets of nodes. Immediately place the cut end in water. Store cut clones



Make a 45-degree cut across the stem to cut the clone.



Trim off one or two sets of leaves.



Hold cut clones in a glass of water until you are ready to dip in hormone and plant.



Dip trimmed stem into the rooting gel or liquid hormone. Make sure stem is covered with the proper amount of rooting hormone.



Place the stem covered with rooting hormone into the root cube.



Pinch the top of the root cube so that growing medium is in full contact with the stem.

in water while making more clones.

Step Three: Rockwool and Oasis™ root cubes are convenient and easy to maintain and transplant. Fill small containers or nursery flats with coarse, washed sand, fine vermiculite, soilless mix, or, if nothing else is available, fine potting soil. Saturate the substrate with water. Use an unsharpened pencil, chop stick, nail, etc., to make a hole in the rooting medium—a little larger than the stem. The hole should stop about one-half inch from the bottom of the container to allow for root growth.

Place a tray containing rooting cubes or plugs into a standard nursery rooting flat. If none exist, make holes through three-fourths of the cube for clone stems.

Fill rockwool tray with water, pH 5-6. Always use strong plastic trays.



Grow clones until they are well-rooted. Always remember to label clones when planting.

Step Four: Use a rooting hormone, and mix (if necessary) just before using. For liquids, use the dilution ratio for softwood cuttings. Swirl each cutting in the hormone solution for 5-15 seconds. Place the cuttings in the hole in the rooting medium. Pack rooting medium gently around the stem. Gel and powder root hormones require no mixing. Dip stems in gels as per instructions or roll the stem in the powder. When planting, take special care to keep a solid layer of hormone gel or powder around the stem when gently packing soil into place.

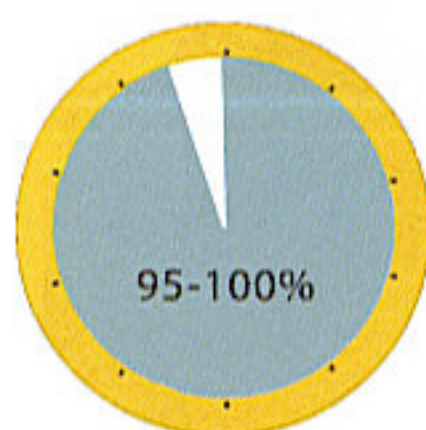
Step Five: Lightly water until the surface is evenly moist. Keep cuttings moist at all times. Clones have no roots to bring water to leaves. Water arrives from leaves and the cut stem until roots can supply it. Water as needed to keep growing medium evenly moist. Do not let it get soggy.

Step Six: Clones root fastest with 18-24 hours of fluorescent light. If clones must be placed under an HID, set them on the perimeter of the garden so they receive less intense light; or shade them with a cloth or screen. A fluorescent tube six inches above clones or a 400-watt metal halide lamp four to six feet away supplies the perfect amount of light for clones to root. Cool white fluorescents (or a combination of warm and cool white) are excellent for rooting.



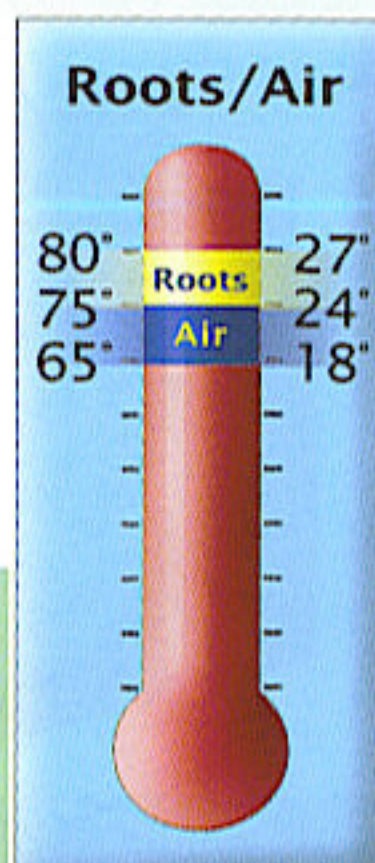
Humidity domes fit over flats of clones to retain humidity. The domes on the right are covered with lightweight Agronet to lower light on new clones.

Rooting Clones



Above: Best humidity ranges for cloning.

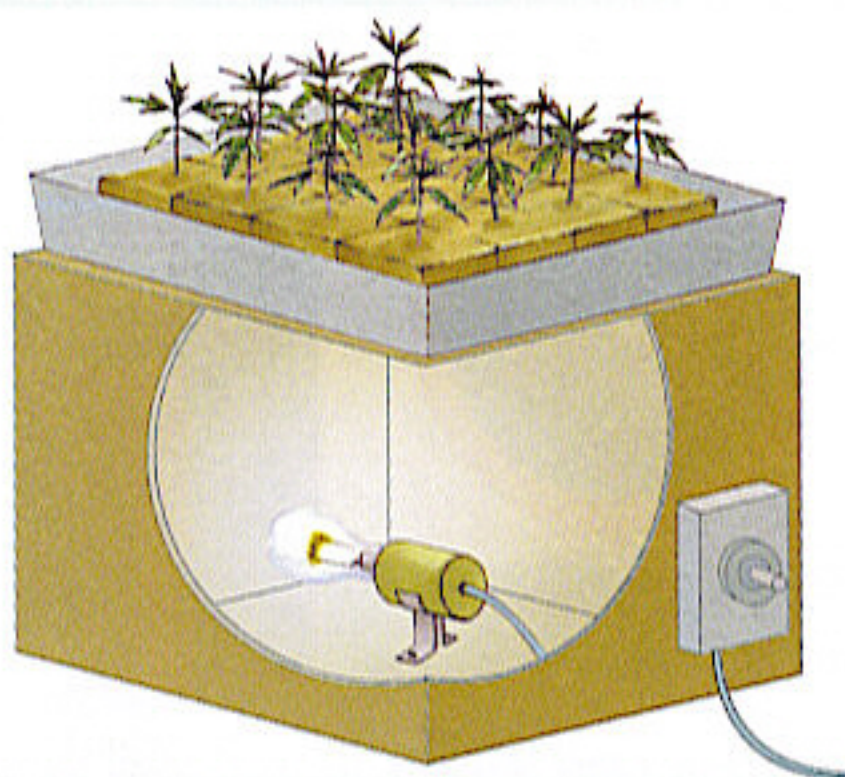
Right: Best temperature range for growing medium.



A fogger in the cloning room will ensure humidity stays above 95 percent.



To lower transpiration, cut clone leaves in half before sticking.



An incandescent light bulb attached to a rheostat provides exacting control of bottom heat.



This large clone has been rooting for a week. The expert grower makes sure the climate is perfect, so clones suffer no stress.



Strong clone in an aeroponic clone garden has a mass of roots and is ready to plant.

Step Seven: Clones root fastest when humidity levels are 95-100 percent the first two days and gradually reduced to 80-85 percent during the following week. A humidity tent will help keep humidity high. Construct the tent out of plastic bags, rigid plastic, or glass. Remember to leave openings for air to flow in and out so little clones can breathe. If practical, mist clones several times a day as an alternative to the humidity tent. Remove any sick, rotting, or dead foliage.

Cut leaves in half to lower transpiration surface and to keep them from overlapping. Moisture that could foster fungus is often trapped between overlapping leaves. Keep the grow medium evenly moist so there is enough moisture to prevent cut leaves from bleeding out plant sugars that attract diseases.

Step Eight: Clones root faster when the growing medium is a few degrees warmer than the ambient air temperature. A warmer substrate increases underground chemical activity, and lower air temperature slows transpiration. For best results, keep the rooting medium at 75-80°F (24-27°C). Growing medium temperatures above 85°F (29°C) will cause damage. Keep the air temperature 5-10°F (3-5.5°C) cooler than the substrate. A warmer growing medium coupled with cooler ambient temperature slows diseases and conserves moisture. Misting clones with water also cools foliage and slows transpiration to help traumatized clones retain moisture unavailable from nonexistent roots.

Put clones in a warm place to adjust air temperature and use a heat pad, heating cables, or an incandescent light bulb below rooting cuttings.

Step Nine: Some cuttings may wilt but regain rigidity in a few days. Clones should look close to normal by the end of the week. Cuttings that are still wilted after seven days may root so slowly that they never catch up

with others. Cull them out, or put them back into the cloning chamber to grow more roots.

Step Ten: In one to three weeks, cuttings should be rooted. Signals they have rooted include yellow leaf tips, roots growing out drain holes, and vertical growth of the clones. To check for root growth in flats or pots, carefully remove the root ball and clone to see if it has good root development. For best results, do not transplant clones until a dense root system is growing out the sides and bottom of rooting cubes.

Cuttings are always strong and healthy-looking after you take them. After five or six days, leaves may start to change color. Leaves stay small and often turn a deeper shade of green. After about a week, lower leaves may start to yellow if their nutrient levels dissipate.

A week after being taken, clones' stems will develop stubby callused roots called primordia. The primordia are semi-transparent to white and should look healthy. Clones produce very little green growth during this process. Once the root and vascular transport system is in place and working properly, clones are able to experience explosive growth with the proper care.

Rooting clones can handle increasingly more light as roots grow. Move the fluorescent lamps to two to four inches above plants when roots form. Fertilize with a mild fertilizer solution when all clones have started vegetative growth.

Any sign of slime, pests, or disease means there are problems, and clones should be removed from the garden.

Transplant only the strongest, well-rooted clones. (See "Transplanting" below.) Slow-rooting clones should be kept in the cloning chamber or culled out. Do not move clones below bright light until they have fully developed root systems. Once transplanted, clones are ready to harden-off (see "Transplanting" below).



This cutting needs to grow a bigger root system before transplanting.



This mass of roots is from a clone with a split stem; the outer layer of the stem was scraped away to expose the cambium.



Plenty of roots are growing from this clone rooted in a Jiffy cube. It is ready to transplant.

Sequence of cloning for sex



1. Make 2 cuttings



2. Label each cutting



12 Hours



3. Give 12 hours of light while rooting



4. Cutting will determine sex in 2-3 weeks

Cloning the apex of the tip



Swiss cloning expert is removing the tip of a mother plant to clone in an agar solution. Such clones are easy to maintain for long periods.

Set-up a vegetative pre-growing area that is lit with an HID or bright compact fluorescent lamp for the rooted clones. Place them in this area to let them grow the first week or two of vegetation. This area needs to be just big enough to accommodate plants from the time they are a few inches tall until they are about a foot tall and ready to be moved into the flowering room.

Air layering

There is a good sequence of air layering in *Marijuana Botany*, by Robert C. Clarke. To date, I have never seen anybody use this technique. It is interesting, but normally not necessary. Cannabis is easy to root or clone.

Cloning for Sex

Determine plant sex accurately, 100 percent of the time, by "cloning for sex." To clone for sex, take two cuttings (in case one dies) from each parent plant in question. Use waterproof labels and an indelible marker to identify sets of clones and corresponding parents.

Give rooting clones a 12-hour light/dark regimen. After a 12-hour day, set clones in a dark closet, or place a box over them. The dark period must be total and uninterrupted to induce flowering. Clones usually show sex within two weeks. Cull out all males except those used for breeding. Flower little females, and keep their mothers growing under 18-24 hours of light.

Growers with only one room root clones in a nursery flat, and cover it with a light-tight cardboard box for 12 hours every night. Remove the cardboard box after the lights go out to increase air circulation and ventilation.

Clones from a Flowering Female

You can clone a favorite flowering plant, but it is difficult. Clones take longer to root, and results are not always the best. Powerful flowering hormones must be reversed, and rooting hormone signals must be sent. Now is the time to give plants 24 hours of light to signal them to grow.

Cut clones from the lower green branch tips. Cut a one to two-inch-long (3-5 cm) stem. Trim off flowers and lower leaves. Keep two or three green leaves. If leaves have yellowed, survival chances diminish exponentially.



You can take clones from flowering plants and revert them to vegetative growth once rooted.

The earlier in the flowering stage cuttings are taken, the more rapid the rooting and the re-vegetation rate. Once a plant reaches the senescence point, growth hormones have dissipated, leaving not enough to initiate roots.

Storing Clones

To store cuttings for later use, wrap recently cut and trimmed stems in a damp cloth or paper towel. Put the wrapped clones into a plastic bag, and store in the refrigerator. On a daily basis, remove the water that condenses inside the bag in the cool refrigerator. Keep the temperature above 40°F (5°C). Temperatures below this level may cause plant cells to rupture. Cuttings should last in the refrigerator for about three weeks.

Clonex Root Matrix, a Growth Technology product, is a gel that allows cut clones to root and be held until they are needed.

Transplanting



Mix the clone dip, and use a rag to cover and contain soil when dipping.



Submerge the entire clone in the dip to ensure miticide covers all foliage.



Remove the clone, and shake off excess dip before transplanting.

Dip rooted clones into a miticidal/fungicidal solution before transplanting and before moving into the flowering room.

Mix a miticidal/fungicidal dip (I like Einstein Oil) to disinfect clones before sticking them in the growing medium. Fill a container with low pH water (5-6) and add a natural fungicide such as hydrogen peroxide in a two percent solution. Or include a ten percent mix of chlorine or vinegar. **Do not mix vinegar and chlorine! The resulting gas is hazardous.** See "Transplanting."

Transplanting

When plants are too big for their containers, they must be transplanted to continue rapid growth. Inhibited, cramped root systems grow sickly, stunted plants. Signs of root bound plants include slow, sickly growth and branches that develop with more distance between limbs. Severely root-bound plants tend to grow straight up with few branches that stretch beyond the sides of the pot. To check for root-bound symptoms, remove a plant from its pot to see if roots are deeply matted on the bottom or surrounding the sides of the pot.

When growing short plants that reach full maturity in 90 days, there is little need for containers larger than three gallons (11 L). Large mother plants will need a large pot if they are kept for more than a few months.



In this container, roots are growing mainly around the sides and along the bottom. This plant is ready to be transplanted.

Transplant into the same type or similar growing medium; otherwise, a water pressure differential could develop between the different mediums, which slows water movement and causes slow root growth. Starting seeds and clones in root cubes or peat pots makes them easy to transplant. Set the cube or peat pot in a hole in the growing medium, and make sure growing medium is in firm contact. Remember to keep root cubes and substrates evenly moist after transplanting.

Transplanting is the second most traumatic experience after cloning. It requires special attention and manual dexterity. Tiny root hairs are very delicate and may easily be destroyed by light, air, or clumsy hands. Roots grow in darkness, in a rigid, secure environment. When roots are taken out of contact with the soil for long, they dry up and die.

Transplanting should involve as little disturbance to the root system as possible. Water helps the soil pack around roots and keeps them from drying out. Roots need to be in constant contact with moist soil in order to supply water and food to the plant.

After transplanting, photosynthesis and chlorophyll production are slowed, as are water and nutrient absorption via roots. Transplant late in the day so transplanted plants will have all night to recover. Transplants need subdued light, so foliage can grow at the rate roots are able to supply water and nutrients. Give new transplants filtered, less-intense light for a couple of days. If there is a fluorescent lamp handy, move transplants under it for a couple of days before moving them back under the HID or outdoors to harden-off.

Ideally, plants should be as healthy as possible before being traumatized by transplanting. But, transplanting a sick, root-bound plant to a bigger container has cured more than one ailing plant. Once transplanted, cannabis requires low levels of nitrogen and potassium and increased quantities of phos-



Roots showing through a rooting cube means cuttings are ready to transplant.

phorus. Any product containing Trichoderma bacteria or Vitamin B₁ will help ease transplant shock. Plants need a few days to settle in and re-establish a solid flow of fluids from the roots throughout the plant. When transplanted carefully and disturbed little, there will be no signs of transplant shock or wilt.

Double potting is a simple transplanting technique that disturbs roots very little. To double pot a plant, cut the bottom out of a root-bound pot, and set on top of another bigger pot of soil. Roots grow down into second pot.

Transplanting Step-by-Step

Step One: Water clone with half-strength Trichoderma bacteria Vitamin B₁, two days before transplanting.

Step Two: Fill the three-gallon (11 L) container with rich potting soil or soilless mix to

within two inches (5 cm) of the top.

Step Three: Water growing medium with a mild, quarter-strength hydroponic fertilizer solution until saturated and solution drains freely out the bottom.

Step Four: Carefully remove the root ball from the container. Place your hand over top of container with the stem between your fingers; turn it upside down, and let root ball



Carefully remove seedlings from containers. These seedlings were kept moist and moved quickly to minimize exposure to air and light. Growers used Vitamin B₁ solution to ease transplant shock.



Transplanting this clone grown in rockwool into soil or soilless mix is simple and easy. Remove the rockwool's plastic covering before setting the clone in a pre-made hole in substrate.

slip out of pot into your hand. Take special care at this point to keep the root ball in one integral piece.

Step Five: Carefully place the root ball in the prepared hole in the three-gallon (11 L) container. Make sure all roots are growing down.

Step Six: Backfill around the root ball. Gently, but firmly, place soil into contact with root ball.

Step Seven: Water with half-strength fertilizer containing Trichoderma bacteria or Vitamin B₁. Soil should be saturated—not waterlogged—and drain freely. If rooting cube and new substrate are not identical, pay special attention to moisture levels. Let rockwool dry out enough so that roots penetrate new growing medium in search of moisture.

Step Eight: Place new transplants on the perimeter of the HID garden or under a screen to subdue sunlight for a couple of days. Once transplants look strong, move them under full light.

Step Nine: Fertilize soilless mixes after transplanting with a complete hydroponic fertilizer that contains soluble chelated nutrients. New potting soil usually supplies enough nutrients for a couple of weeks before supplemental fertilization is necessary.



This clone grew in a four-inch (10-cm) pot and is ready to be transplanted.

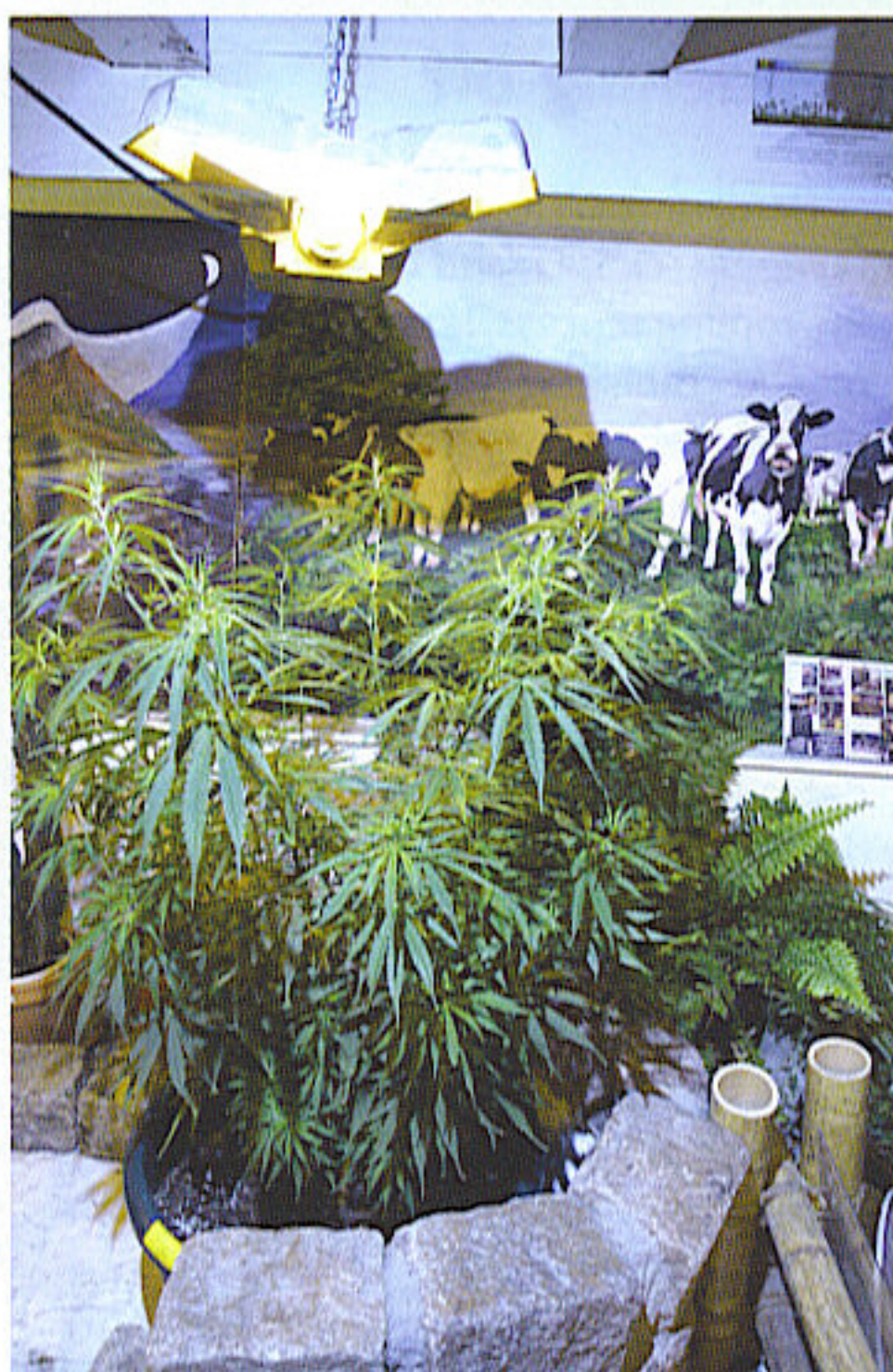
Step Ten: Minimum Container Size chart below.

Minimum Container Size	
Plant age	Container size
1-3 weeks	root cube
2-6 weeks	4-inch (10 cm) pot
6-8 weeks	2-gallon (7.5 L) pot
2-3 months	3-gallon (11 L) pot
3-8 months	5-gallon (19 L) pot
6-18 months	10-gallon (38 L) pot

Seedlings and clones can also be transplanted directly into a three- to five-gallon (11-19 L) pot, a system which requires fewer containers and involves less work and less possible plant stress. The larger volume of soil holds water and nutrients longer and requires less frequent watering. When clones and seedlings are transplanted directly into a five-gallon (19 L) container, the roots grow down, out, and around the container walls and bottom. In fact, the majority of roots grow out of the soil and form a layer behind the container wall.

To encourage roots to develop a dense compact system, transplant just before they have outgrown their container. Transplanting a well-rooted clone in a root cube into a four-inch (10-cm) pot and transplanting the four-inch (10-cm) pot into a three-gallon (11 L) pot or grow bag causes roots to develop a more extensive system in a small ball of growing medium. Successful transplanting causes minimal stress. Most marijuana crops are in the ground for such a short time that bungled transplanting costs valuable recuperation time and loss in production.

Transplant clones and seedlings into raised beds and large planter boxes directly from four-inch (10-cm) pots. As many as 20 plants can be transplanted into a 24 × 24 × 12-inch (61 × 61 × 30 cm) planter, but six to twelve plants will yield about the same dry weight of buds. Once plants start crowding and shading one another, bend stems outward and tie them to a trellis attached to the planter.



This clone was transplanted directly into a large container at the Cannabis College in Amsterdam.

Large planters require less maintenance. The larger mass of soil retains water and nutrients much longer and more evenly. One downside is that all plants must receive the same water and diet.

Three-gallon (11 L) containers are the ideal size for two- to three-foot-tall (60-90 cm) plants. Larger pots are usually unnecessary because plants grow no longer than a week or two in the vegetative stage and six to ten weeks flowering. Smaller three-gallon (11 L) pots are easy to move and handle. Roots also grow less during flowering. By the time a plant is potbound, it is ready to harvest. I used to recommend up to a five-gallon (19 L) container for plants that are harvested after 90 total days of life. I now believe this is a waste. While the smaller containers require

Hardening-off

Hardening-off is the process of toughening-up clones and seedlings. During the rooting process, leaves supplied much of the moisture for the clone. Now, healthy white new roots are supplying moisture to the clone. Check for root damage. Brown roots are rotting and lack oxygen. Thin hair-like dark roots are dried out. Once damaged, roots remain damaged. New roots must grow to replace damaged roots. Cull out any clones with damaged roots, because they will grow slowly. The protective wax coating must also grow back on leaves. It is best to acclimate rooted clones to the grow room over the course of a week. Gradually hardening-off clones will assure they suffer a minimum of stress and continue to grow rapidly.

Harden off the strong ones, and introduce them to the real world—the grow room where they will see photosynthetically active response (PAR) at full value and nutrients that make their cells quiver. Now is the time to pre-grow clones before placing them into the flowering room.

Foliage loses its protective wax coating when it is pampered during cloning, so it is very tender now. New roots must start to transport water via the stems to the leaves. The roots and moisture-transport system start to work on strong, healthy clones first. Clones that lag behind now should be tossed out, because they will always be slow. You can let them root longer and not transplant them until adequate roots develop.



These beautiful little seedlings were started indoors under a fluorescent lamp. The grower moves them outdoors for a few hours every day to harden-off and acclimate to the outdoor environment.



This female was pruned and bent to keep a low profile and open up the center of the plant.

daily watering, they produce harvests comparable to those of five-gallon (19 L) containers.

Mother plants are much larger, grow longer, and can require containers up to 30 gallons (115 L) in size. However, mother plants grow quite well in five or ten-gallon (19-38 L) hydroponic containers for a year or longer. If you plan to keep a mother plant for more than a few months, grow it hydroponically in its own container for best results.

Pruning and Bending

Pruning and bending a plant redirects growth hormones. Pruning affects the plant more drastically than bending. Selective pruning and bending allow us to manipulate auxin hormone levels in branch and flower tips. Removing or bending a branch or branch tip causes hormonal balances to shift. Cutting the meristem (top growth tip) of a cannabis plant will diffuse auxins and cause greater concentrations in lower branch tips. Bending a growing tip changes hormone concentrations less than pruning.

Pruning

Always use clean instruments when pruning. A straight razor, single-edge razor blade, a sharp pair of pruners, or a pair of scissors all work well. Sanitize clippers and blades between cuts by dipping in rubbing alcohol. Use indoor pruners *only* in the indoor garden. Pruners used outdoors have everything from spider mites to fungus spores on them. If outdoor clippers must be used, dip in rubbing alcohol to sterilize before making cuts.

After pruning, the open wound invites diseases and pests. Wash your hands and tools before and after pruning. Make cuts at a 45-degree angle to discourage moisture from sitting on wounds.

Avoid pruning up to a month before inducing flowering. Since pruning diffuses floral hormones, flowering is retarded. If heavily pruned shortly before flowering, peak maturation is delayed for a week or longer. It takes a month or longer for hormones to build up to pre-pruning concentrations.

Leave leaves alone! Removal of healthy leaves hacks up a healthy plant. Removing large fan or shade leaves DOES NOT make plants more productive. This practice DOES NOT supply more light to smaller leaves and growing tips. Plants need all their leaves to produce the maximum amount of chlorophyll and food. Removing leaves slows

There are a few basic techniques to pruning marijuana, including:

Prune off the top of the plant below the first set or two of branches to drive hormones to lower branches. Pruning off more of the main stem will increase the effect.



Prune off the tip of plants to diffuse hormones and make lower branches grow more.



Prune the tips of all branches except the main tip to make plants tall.



Remove lower branches that do not receive light. Plants will direct energy into buds.





Pruning off all lower branches makes inspecting irrigation fittings easy and diminishes problems associated with weak growth.



No pruning was done in this room. Buds were so big in this room that plants were staked with bamboo sticks.

chlorophyll production, stresses the plant, and stunts its growth. Stress is a growth inhibitor. Remove only dead leaves or leaves that are more than 50 percent damaged.

Remove spindly branches and growth that is not collecting light energy, including dead and dying leaves. Pruning lower branches concentrates auxins in upper branches which forces growth upwards. Cut lower branches off cleanly at the stem so no stub is left to rot and attract pests and diseases. If you must harvest a little smoke prematurely, removing a few lower branches will diminish the harvest the least.

Pruning out spindly branches and growth inside plants opens up the interior and provides more and better air circulation. It also allows light to reach deeper inside plants.

Not pruning has several advantages. Floral hormones are allowed to concentrate in tips of branches causing buds to grow stronger and denser. Unpruned plants are crammed into a small area. Crowded plants have less space to bush out laterally and tend to grow more upright. Clones are set into the flowering room after 1-30 days in the vegetative



Pruned plants often seal themselves, but problems can still arise when there is an appealing opening for pests.

room. All the little clones are packed tightly together in three-gallon pots. Each one of the plants is taking up the minimum amount of space for the minimum amount of time to produce the maximum amount of marijuana. Light is much more intense, and the entire plant grows flower tops with few fan leaves.

Most successful growers do not prune at all, especially if growing a short clone crop that is only two to three feet (61-91 cm) tall. Short clone crops require no pruning to increase light to bottom leaves or to alter their profile. "No pruning" is the easiest and most productive method when growing short crops.

Pinching back or pruning tops (branch tips) causes the two growing shoots just below the cut to grow stronger and bigger. This increases the number of top or main buds. Pruning tops also diffuses floral hormones. These hormones (auxins) prevent the lateral buds from growing very fast. All lower branches develop more rapidly when the terminal bud is removed. The further a branch is from hormones at the plant tip, the less effect the auxins have.

To pinch back a branch tip, simply snip it off below the last set or two of leaves. Pinching off tender growth with your fingers helps seal the wound and is often less damaging to plants than cutting. When the main stem is pinched back, side and lower growth is stimulated. When all the tops are pinched back, lower growth is encouraged. Continually pinching back, as when taking clones from a mother, causes many more little branches to form below the pruned tips. Eventually, the plant is transformed into a hedge-like shape. Most growers do not pinch plants back, because it diminishes the yield of prime, dense tops; but it may not affect the overall weight of dried smoke.

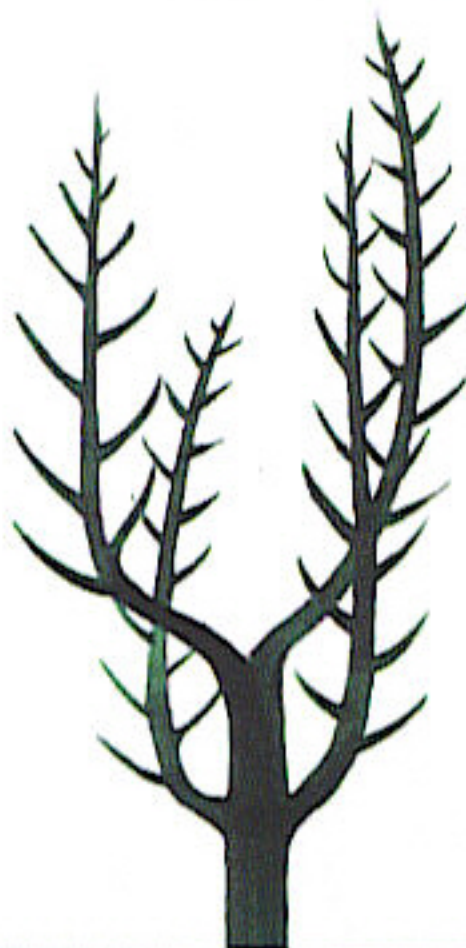
Supercropping is a form of pinching back or pruning branch tips. We are not sure who or when the term or buzzword was coined. We do know that there are several different



The main growing tips of this large patio plant were pruned off, which stimulated lower growth.

versions of supercropping "invented" by innovative growers.

Supercropping can also incorporate FIM pruning which is explained below. It can be



Floral hormones are concentrated in four main branches.

combined with bending, too. Some people go to the point of mutilating plants by breaking branches a few inches below main buds. Removing healthy leaves so that "budding sites get more light" is also practiced by some supercroppers. See "Stress" below for more information.

Pruning all the branches or removing more than 20 percent of the foliage in a short time frame stresses plants too much and diminishes harvest. But if taking clones, some growers effectively prune a mother down to stubby branches and let her recuperate for a month or longer.

Pruning too much over time may alter hormonal concentrations, causing spindly growth. This is often the case with mother plants that provide too many clones. The mother must rest and gain girth, because small, spindly branches root poorly.

Remove all but the four main branches. The meristem (central stem) is removed just

above the four lowest (main) branches. Removing the central leader concentrates the floral hormones in the four remaining branches. Fewer branches are stronger and bear a larger quantity of dense, heavy flower tops. Remove the stem above the four main branches; do not remove leaves on the main branches. Select plants with three sets of branch nodes about six weeks old, and pinch or prune out the last set of nodes so that two sets of branches remain. Move plants into the flowering room when they are about 12 inches tall. 'Skunk #1' and similarly robust bloomers should be set in the flowering room when about six to eight inches tall.

The FIM Technique was coined by an anonymous *High Times* reader from South Carolina in the July 2000 issue of the magazine. The technique has become legendary on www.overgrow.com, ever since the grower wrote: "this pruning technique could rev-

FIM Technique



The drawing on the left shows the traditional method to top a plant. The entire growing shoot just below the bud is removed. When the entire growing shoot is removed, the two buds located directly below the cut grow faster and stronger. The drawing in the center and the close-up on the right show the FIM pruning technique – the bottom ten percent of the bud remains intact. This is the key to FIM pruning. Many different flowering tops form as a result of this single pruning. According to FIM aficionados, terminal buds put on much more weight and are more dense.

olutionize indoor gardening." The South Carolina grower tried to pinch the tip of a plant and said "Fuck, I Missed!" when he did not remove the entire bud and coined the acronym FIM.

Bending

Bending is similar to pruning, in that it alters the flow of hormones. Bending efficiently neutralizes the effect of the growth-inhibiting hormone. Bending is much easier on plants than pruning. To bend, lean a branch in the desired direction and tie it in place. Branches can take a lot of bending before they fold over or break. Even if a branch folds, tie it in place; if necessary, use a wooden splint. The stem will heal itself. Young, supple branches take bending much better than old, stiff ones. Bending branches horizontally will encourage the buds to grow vertically towards the light. Each bud will

turn into an impressive top, because they all receive more light. A wooden planter box with a lattice trellis alongside makes a great anchor to tie bent plants to.

Wire ties, the kind used to close bread sacks, can be purchased at a nursery. Wire ties are either pre-cut or cut to length by the grower. Plastic-coated electronic and telephone cable wire also work well. They are fastened with a simple twist and stay rigid, leaving the stem breathing room. But if applied too tightly around a stem, the liquids cannot flow, and death could result.

Be gentle when bending, even though cannabis can take much abuse. Sometimes a crotch will separate or a branch will fold over, cutting off fluid flow. These mishaps are easily fixed with a small wooden splint snugly secured with wire ties or duct tape to support the split and broken stem.



Bending plants will give them a low, inconspicuous profile.

Growers also combine bending and pruning. It is easy to prune too much, but it is hard to over bend.

Air Pruning Roots

When roots grow to the end of the container and are exposed to air, they stop growing. The air naturally prunes roots. They cannot grow out the end of the pot, because the climate with little moisture and lots of air is too inhospitable.



Two plants growing in this ten-gallon (38 L) pot have been trained to grow along a wall just out of the neighbor's field of vision.

Root Pruning

Root pruning could be necessary to give new life to potbound plants outdoors or in greenhouses. Removing roots will not make plants grow faster; in fact, it will slow growth for about two weeks. Once new roots start to



Roots on these clones grow through the drainage holes. Once they hit the air, growth stops. Roots are "air pruned."



Bending branches lowers the garden profile and allows sunshine to reach smaller buds.

grow, growth rebounds. About mid-summer, root-prune plants that must stay in the same size container. Root pruning will keep plants manageable and much easier to maintain.

Chemical Root Pruning

Chemical root pruning is an excellent way to control root growth inside containers. Commercial nursery people have been using chemical root pruning for many years with outstanding results. This passage is condensed from an excellent FAQ article on chemical root pruning with great photos by Uncle Ben at the following link <http://www.overgrow.com/growfaq/1321>.

Uncle Ben used a product called Griffin's Spin-Out that consists of copper hydroxide suspended in a carrier. To use, simply spray-paint the inside of the containers with two coats of Griffin's Spin-Out. Roots grow to within a fraction of an inch of the copper hydroxide, then stop and turn! Roots will not touch the unpleasant compound. The result is similar to what happens aboveground when new, lower growth is stimulated as branch tips are pruned. When pruned with



To remove large plants from containers, use a knife or blade to separate roots from the inside of the container. Move the blade up and down all the way around the inside of the container to break roots away.



The roots in this potbound plant form a mass around the interior and bottom of the container. Roots that grow out drainage holes are "pruned" when they come into contact with air. This plant needs repotting.



Remove the root ball from the container.

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copper hydroxide paint, more roots develop overall, and they grow in the *entire* root ball, especially in the center. Plants with a dense root system dispersed evenly throughout the root ball are easier to maintain, and they grow bigger in smaller containers.

Grafting

Little is known about grafting cannabis. Yes, it is possible to graft cannabis to hops. Most often the hop stem is grafted to a cannabis rootstock. The plant will live; however, it will not produce THC.

I asked a number of growers if they had experimented with grafting, and none had. Grafting an *indica* stem to a large *sativa* rootstock would be an interesting experiment.



Gently remove a portion of the soil from the root ball. I like to remove the part in the center of the root ball where few roots reside.

The larger root system could easily supply water and nutrients to the smaller *indica* plant. The resulting plant would be drought resistant.

Stress

Cannabis grows best and produces heaviest when it is given a stable environment. Stressed plants produce less than unstressed plants. Stress-induced trauma include withholding water, photoperiod fluctuation, low light intensity, ultraviolet light, nutrient toxicities and deficiencies, cold and hot soil, ambient temperatures and mutilation. In addition, any overt applications of growth hormones such as B9 hormone, gibberellins,



Once 30-40% of the soil has been removed, lay a base of fresh soil in the bottom of the container and fit remaining root ball on top of it. Fill the container with fresh potting soil and gently pack in place. After transplanting, water heavily with a Vitamin B1 solution.

cytokinins, abscisic acid, ethylene, colchicine, etc., cause stress.

Stress can cause plants to produce more resin, but it simultaneously causes odd and/or reduced growth. For example, Felix, a Swiss outdoor grower, grew a field of cannabis at 900 feet (300 meters) and another at 4200 feet (1300 meters). The upper field suffered stress, because it is exposed to cooler temperatures and more ultraviolet radiation. Plants there produce about 25 percent more resin-packed THC than plants in the lower field. But, plants that grow at 900 feet (300 meters) yield at least 25 percent or more dry weight than plants at the 4200-foot elevation.

Removing large green shade leaves allows more light to shine on smaller leaves, but it also causes growth to slow and harvest to diminish. Remove only leaves that are more than half damaged by pests or diseases. Often, partially yellow leaves green up once stress is eliminated. Removing spindly, dimly lit lower branches stresses plants much less than removing leaves to speed growth of upper foliage.

Mutilating plants by breaking the trunk, driving a stake through the trunk, torturing or slapping them around might increase resin production, but most often the stress retards growth and causes other problems. Withholding water may also cause more



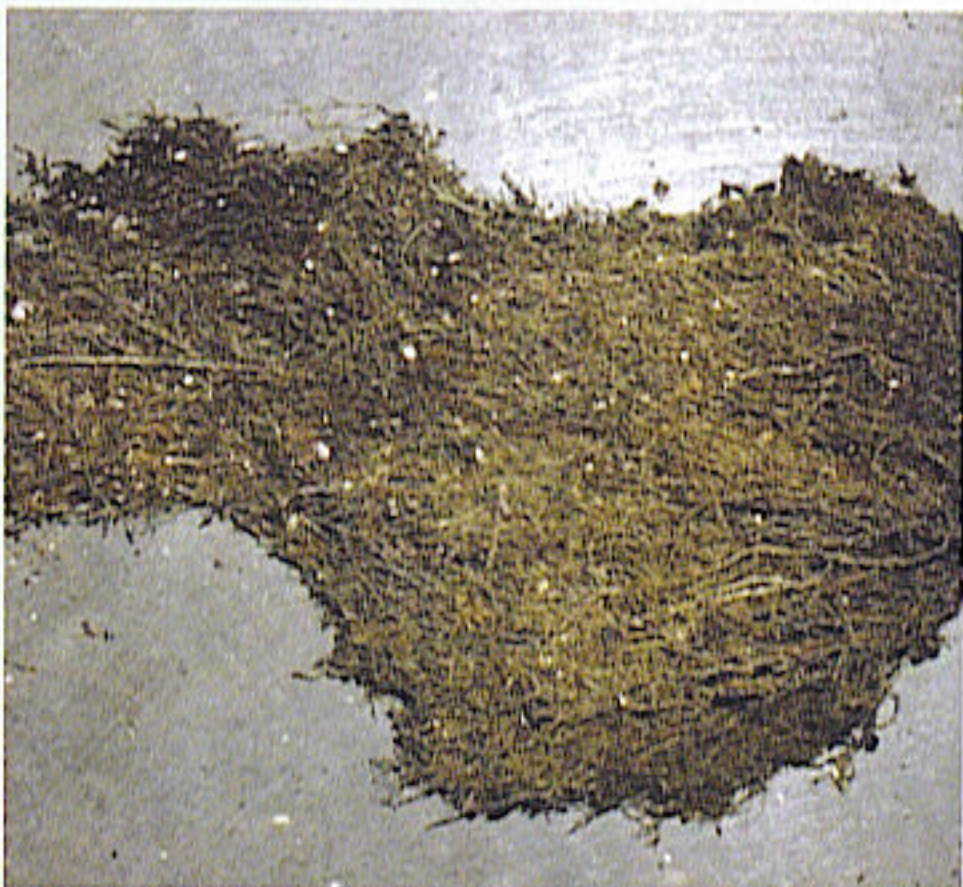
Insides of pots have been painted with Griffin's Spin-Out containing copper hydroxide to prune roots.



This close-up of a root ball shows a spot scraped away with roots behind. This demonstrates the roots will not grow into the copper hydroxide coating.



Stressed plants with wounded stems and vegetation grow slower and invite pests and diseases.



This photo of the foot-long fibrous mass of roots was taken after Uncle Ben shook off much of the semi-dry soil.

resin production, but it impairs growth and diminishes leaf, stem, and flower production. Water stress slows or stops clones from rooting. If clones have too many leaves and are too busy transpiring, root growth is very slow. Conversely, waterlogged rooting mediums harbor no air, and rooting is also slowed to a crawl.

Stress can also affect plants' sex. See Chapter Sixteen, *Breeding*, for more information.



This little plant, nicknamed "Lola," was stressed and stunted by lack of water. Although a beautiful little female, the harvest weighed in at a meager 0.08 ounce (2.3 gm).